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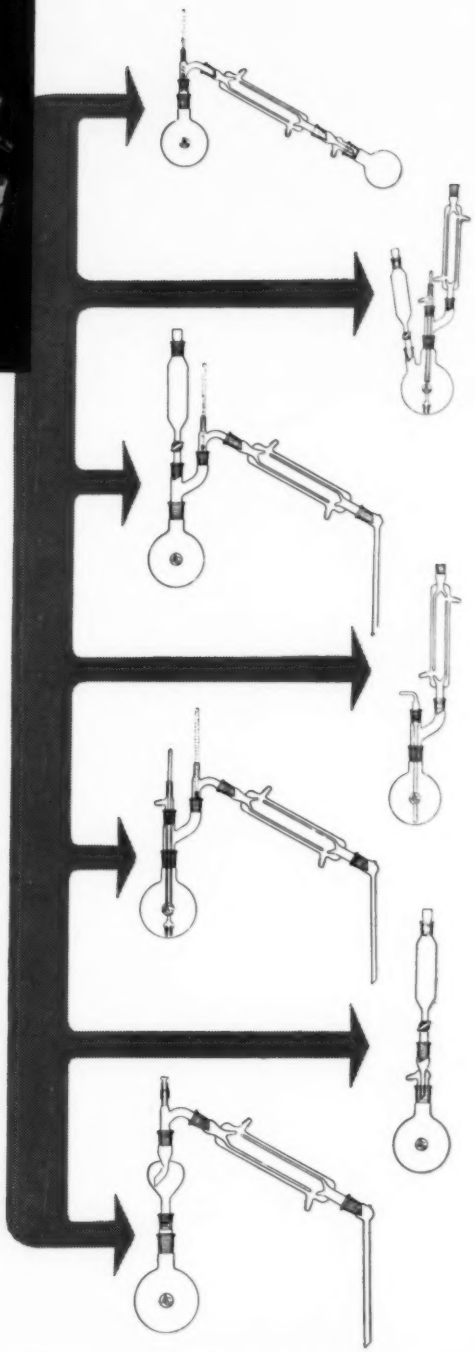

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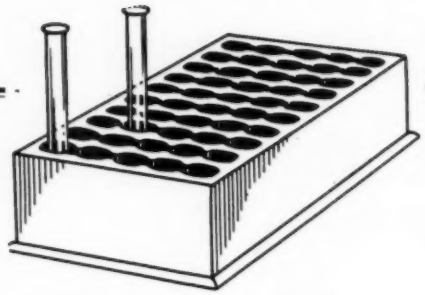

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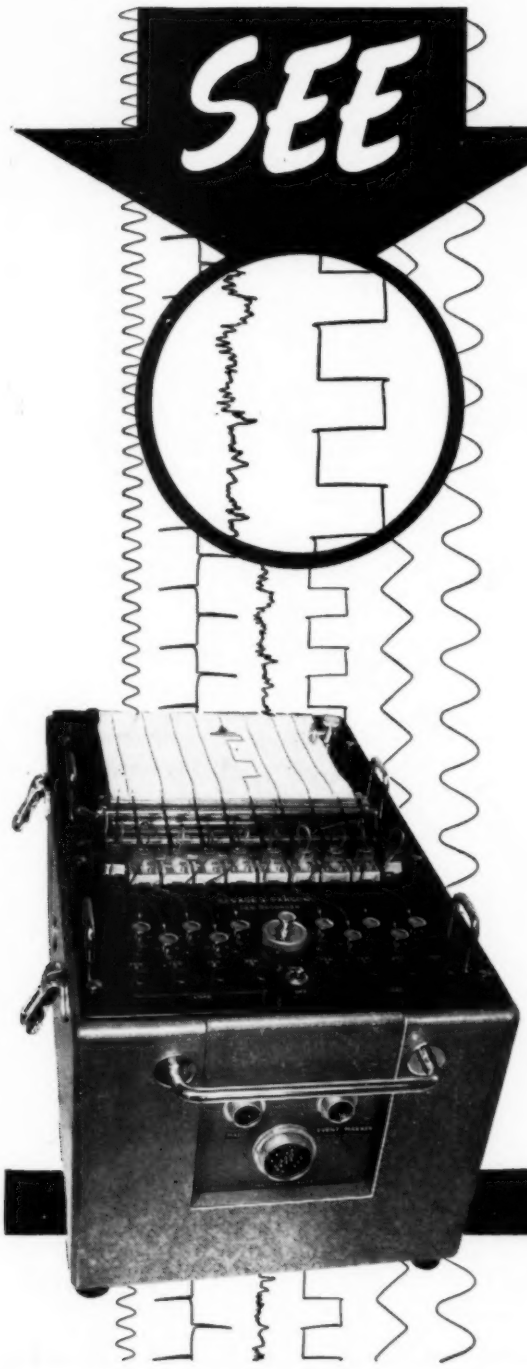

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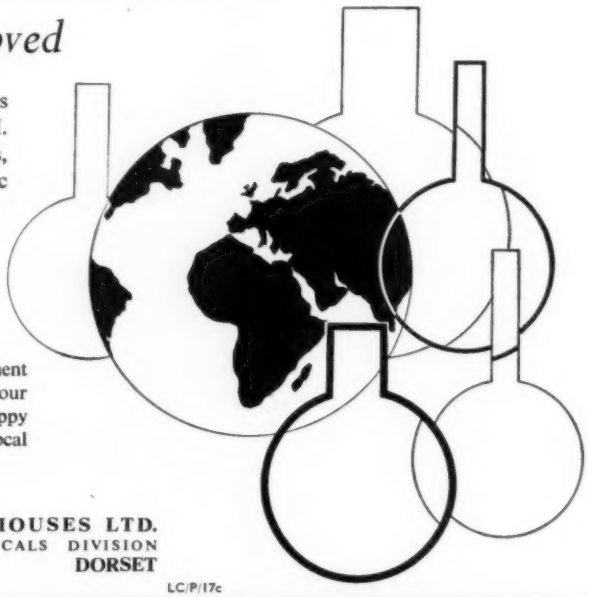

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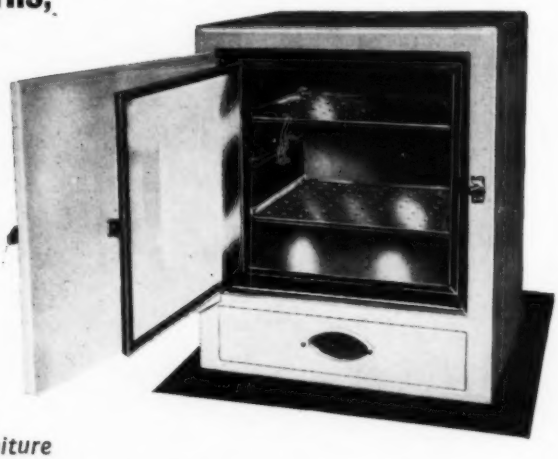

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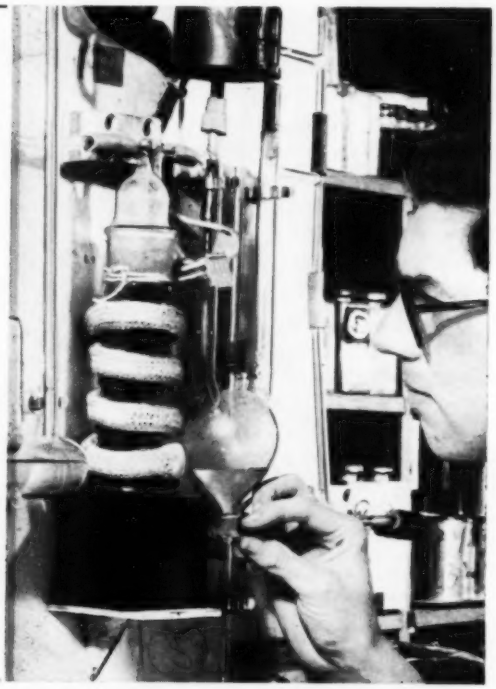

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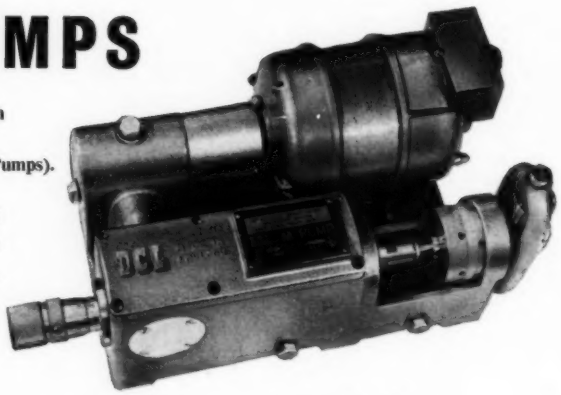

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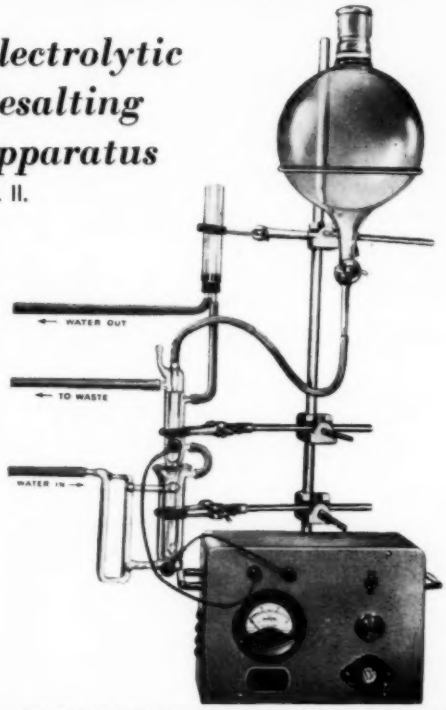

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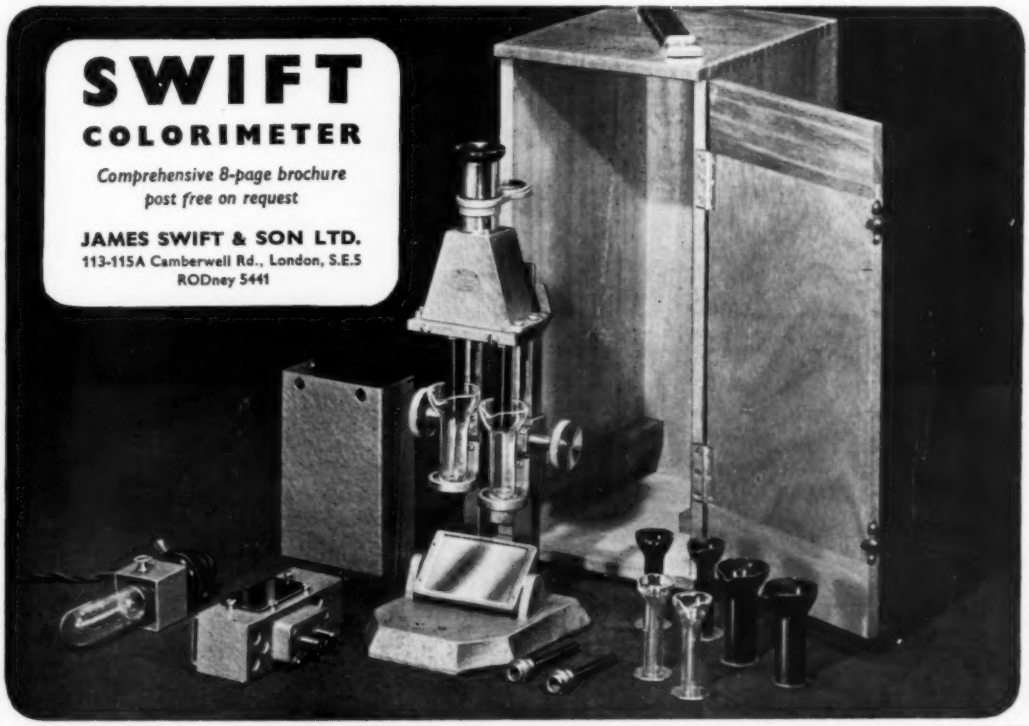

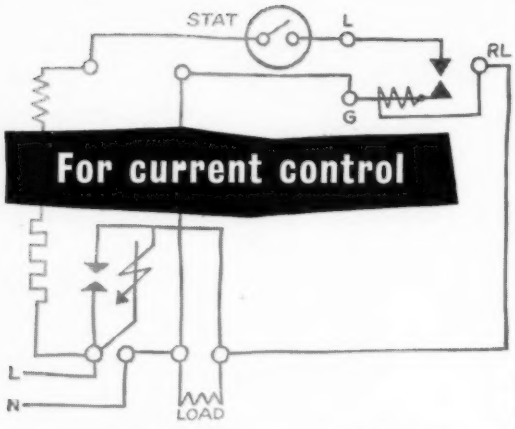

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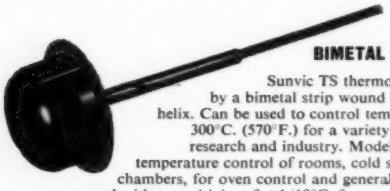

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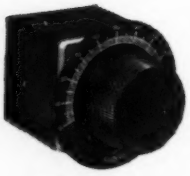

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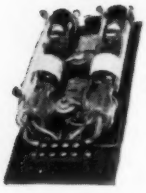

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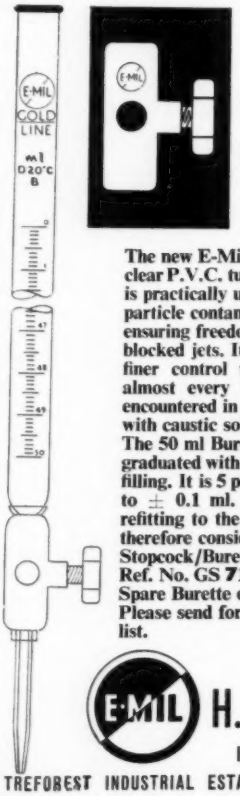

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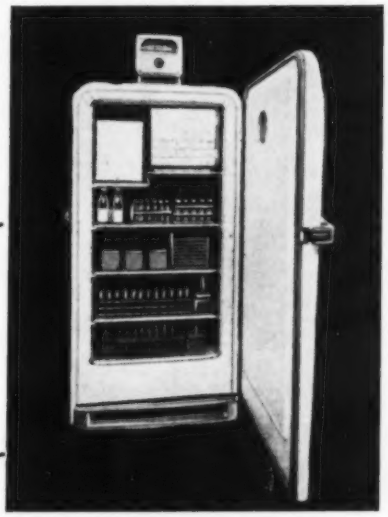

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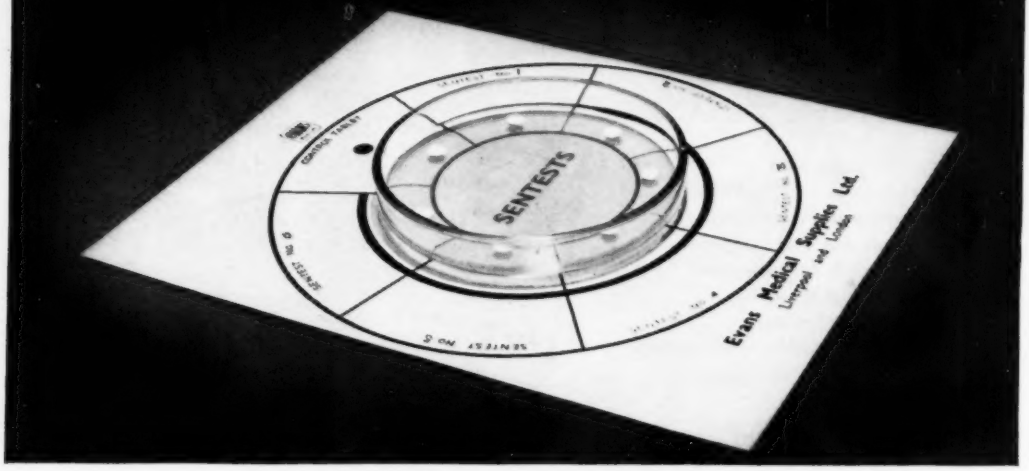

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EDITORIAL

Research in Microbiology

NEXT to nuclear physics or atomic science, possibly the science which has advanced the most is microbiology. This discipline has made its impact both in practice and in theoretical aspects, although these classifications are really quite unreal in science. What is dismissed as of 'only fundamental' importance today has a habit of becoming severely practical tomorrow. When he first split the atom Rutherford had not the slightest idea of where his basic discovery would lead. The early observations on penicillin by Fleming, an original member of our Scientific Advisory Committee, were not only quite unappreciated but any suggestions of its possible therapeutic use were laughed at, and positive attempts were even made to suppress the notion. In this age when violence in some form or other is responsible for more deaths in civilized countries than any other cause, it is as well to remember that antibiotics, of which penicillin is still from all points of view the best, have already saved the lives of many millions of people all over the world. Nuclear physics seems to work in the reverse direction.

On the fundamental side the advances in bacterial genetics and virus studies, especially bacteriophages, have taken us nearer that point where we shall ultimately understand all the essential mechanisms of the living organism, and perhaps begin to understand and later control some aspects of human behaviour (we avoid the word 'personality') through biochemistry.

Thanks to the atom bomb (if human beings were really civilized we could have said 'thanks to penicillin') science has become a first priority of governments, and grants are now made for research which would have seemed fantastic 30 years ago. Scientists are in urgent demand and research units are expanding rapidly and multiplying. There is, however, one curious exception to this general trend. The research council of the D.S.I.R. has decided to disperse the microbiology group of the National Chemical Laboratory at Teddington (see page 69). This seems an extraordinary decision from many points of view. Even non-scientists will appreciate that it takes years to build, equip and train a team of specialists. This team now has over 30 years experience

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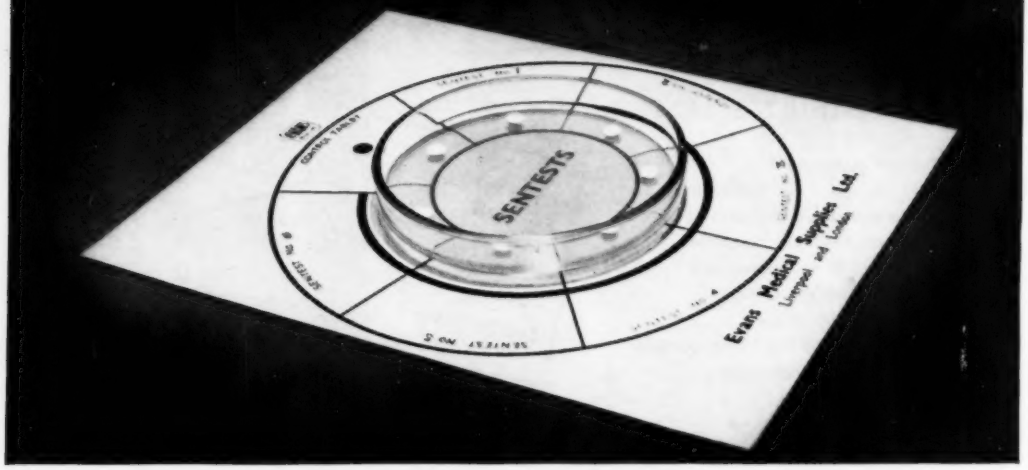

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in the field of general industrial microbiology and has achieved an international reputation in the fields in which it has worked, for example in corrosion of microbiological origin and the study of the sulphur bacteria. The team is not large, nor are its premises extensive by modern standards. Its budget is modest compared with other institutions engaged on similar types of work.

This group is now to be thrown like early Christians to the lions, and various lions are to get various Christians. Perhaps the most amazing decision is that work on microbiological corrosion is to be continued in the National Chemical Laboratory. In any microbiological unit there must be certain items maintained as an overhead—a collection of cultures, basic equipment such as incubators, centrifuges, microscopes, physical instruments, many of which are quite expensive, a department for washing up and sterilizing apparatus, a media making kitchen, and so on. All these are essential to any microbiological team, and these must now be maintained for one small unit of the team. The more these overheads can be spread, the cheaper they become.

The collection of industrial micro-organisms is to be maintained at the Torry Research Station 'where there is already a comparable collection of marine bacteria'. Why not transfer the marine bacteria to Kew where there is already a comparable collection of tropical fungi?

The fundamental work on the sulphur bacteria is to be ended, although this has been indisputably the greatest contribution made by the Teddington workers. Work in this field, and on the microbial formation of methane, 'may be supported in a university'. This is not only a vague statement but an unsatisfactory one. Research on a major product requires continuity and therefore an established team and continuity of effort and control. This cannot be guaranteed by a succession of postgraduate students at a university who usually leave as soon as a better job materializes for them. If, as has been suggested, the work on sulphur bacteria may prove to be of national importance in the event of a third world war, it seems extraordinary for it to be left to the caprice of one or more temporary research workers in a university.

The Council for Scientific and Industrial Research is of the opinion that 'an industrial microbiology team is able to do the best and most effective work when it operates within a research laboratory concerned with the technology served by the team'. We heartily agree with this general principle, and also with the fact that the work of the Microbiology Group at Teddington has been concerned with more than one technology, e.g. metallic corrosion, water pollution and fermentation production of chemicals. There is certainly justification for some of the new suggestions, for example the transfer of water pollution microbiology to Stevenage, but it is difficult to justify others. It appears to have been overlooked that there will always be some problems in microbiology that cannot be linked closely with a well-defined technology, just as there are 'homeless' problems in other sciences. 'Industry' is after all a very broad word. If there is insufficient microbiology in some technologies to justify a research group, surely it is better to maintain a small 'omnibus' group than disband an existing group of very experienced specialists and abandon some of the work altogether. Quite apart from administrative aspects, the psychological effect on research microbiologists in this country will be distinctly unfortunate. The net result of this re-organization seems to be that we shall lose yet a few more of our brightest research workers to America. It is possible that the group has not covered a sufficiently wide field, or tackled the most important problems in industry, or in some way not followed the best policy. If this is so it is a criticism of the directing authority as much as of the microbiologists themselves.

Finally, it is obvious that the microbiologists concerned who are protesting, together with their colleagues in other laboratories, against the decision to disperse the team are not free from bias. Can the same be said for those who have made the decision? It would be reassuring to know that proper advice had been taken, and that the decision had been made by disinterested persons.

Summaries of Research at MERL

The Mechanical Engineering Research Laboratory D.S.I.R. is preparing short summaries of the results of recent research of direct industrial interest to help firms to keep in touch with its work. They will give straightforward accounts of work still in progress at MERL as well as the main findings of completed investigations. They are intended for circulation to senior management as well as to design and production staff.

Among subjects covered from time to time will be: fatigue and creep of engineering materials and components; bearings, lubrication and wear; performance of gears and other mechanisms, engineering metrology and noise control; design and performance of hydraulic machinery; heat transfer and applied thermodynamics; and machining, extrusion and other metalworking processes.

Engineers and industrial organizations who would like to receive copies of MERL Research Summaries are invited to send their names to: The Director, Mechanical Engineering Research Laboratory, East Kilbride, Glasgow.

Recent British Standards

Methods of Testing Vulcanized Rubber

Following its policy of revising B.S.903:1950 'Methods of testing vulcanized rubber', the British Standards Institution has now issued Part A12—*Method for the determination of rubber-to-fabric adhesion (ply separation)* (price 5s.). The main difference between this publication and Part 31 of the 1950 edition is in its layout and the incorporation of the appropriate metric equivalents.

The new Part specifies the machine method and the dead load method, both for the determination of adhesion, and a proof test. Each method is accompanied by details of the test pieces, apparatus, temperature and report.

Copies of this Standard are available from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

HINGED CAMLAB MAJOR CLAMP

Manufacturers: Camlab (Glass) Ltd., 50 Burleigh Street, Cambridge

Price: £1.

THIS clamp is of the type normally used with a retort stand. Its special claim is that it is more versatile than the usual clamp and can be used on larger objects. Its special feature is a hinged jaw. The screw that parts the jaws is long and the curve of the jaws starts about 3 in. from the screw. The combined effects enable the jaws, which consist of red rubber-covered double prongs 1 in. apart, to be opened more than 6 in.

One pair of prongs is fixed on one side, but the pair on the moving arm has a hinged attachment at its centre which enables this jaw to be rotated through nearly 180°. The jaws are 4¼ in. long. The clamp is a robust piece of apparatus finished in black enamel.

Experimental

The tests on this piece of equipment consisted of clamping it round apparatus of various shapes and sizes and seeing how well it held them. It was found to fit all objects from 1¼ in. to 6 in. diameter and to work best with cylindrical objects, i.e. those with a continuous surface around which the jaws could fasten.

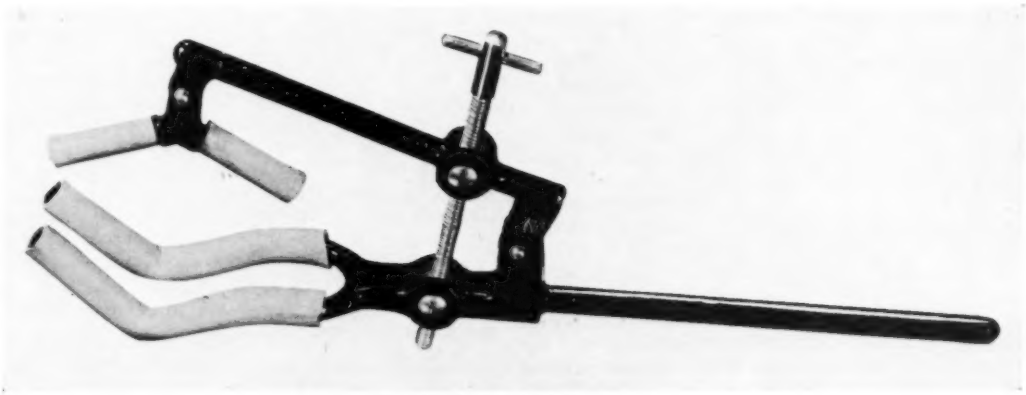
When clamped across diagonal corners of a rectangular object the hinged jaw tends to slip, only being held in position at one point and having no surface to prevent the ends from moving. This point is accentuated when used on a more acutely angled piece of apparatus or across a discontinuous surface, e.g. the legs of some piece of equipment. For any hinged object to remain firm it must be held in at least two positions and on a regularly curved surface this is easily done. Clamping at a point, however, allows the hinged jaw to slip, but as most equipment needing clamping is curved, e.g. flasks, beakers, etc., this is not a very important point. When clamping objects less than 1 in. high, only one prong should be used or the object slips through the middle.

Comments

This clamp fills a long felt want. When fitting up equipment it is often infuriating not to be able to clamp in a desired position either because the clamp does not fit it or because it is not manoeuvrable. This clamp has two great advantages—a wide range of operation, and a hinged jaw which enables it to be pushed into awkward positions. Ideally the curvature of the clamp should be the same as that of the object, which short of having a separate clamp for each article, is an impossible condition. The manoeuvrability of the hinged jaw, however, goes a long way towards solving this problem.

The rubber covered jaws give a firm but not harsh grip, and here only one recommendation can be made. We suggest that the hinge bar be lined with rubber like the rest of the jaw so that the hard metal surface would not press on to the glass or whatever material was being clamped.

The clamp shows a fault common to many similar pieces of apparatus: the enamel finish chips off fairly easily. Considering the rough work that clamps have to do it is suggested that a better finish would be desirable, and we understand the manufacturers have this matter in hand.



The hinged Camlab Major clamp.

Methods used for the Assay of Extracts which contain the Hormones of the Posterior Pituitary Gland

by Fay Johnston, B.Sc.

Department of Materia Medica and Therapeutics, University of Glasgow

PART V

Dicker (1953)

Dicker introduced a more refined version of this assay. Female rats were used and were deprived of food for 18 hours before the experiment but were allowed access to water. The first water load by stomach tube was 5 ml. per 100 g. body weight of tepid water, followed 45 minutes later by 5 ml. per 100 g. body weight of a 12 per cent ethanol solution in water. The bladder and one external jugular vein were cannulated with polythene tubing and the bulk of the bladder was tied off so as to decrease the dead space. When the rate of urine excretion reached 3 to 4 ml. per hour, a second oral dose of a 2 per cent ethanol solution, 3 to 4 ml. per 100 g. body weight, was given and the stomach tube was left in position. When the water load (water load = amount of water administered, minus volume of urine excreted) was about 8 ml. per 100 g. body weight, the animal was placed in a holder attached to a balance (Boura and Dicker, 1953). The jugular vein was connected to a set of three syringes (one tuberculin syringe containing 0·9 per cent w/v sodium chloride, and two 'Agla' micrometer syringes), and the bladder catheter and stomach tube were connected respectively to the outflow and inflow mechanism of the apparatus (Boura and Dicker, 1953). This ensured the recording of urine flow and the maintenance of a constant water load. The rat was fed with 2 per cent ethanol and to cancel out extrarenal losses, the stomach tube inflow mechanism was adjusted to deliver 0·103 ml. for each 0·1 ml. of urine excreted. The experiment was conducted in a thermoregulated room at 23°C. It was found that a lag of two minutes occurred from the time of injection to the onset of the antidiuretic effect. In addition, repeated injections of similar amounts of vasopressin at intervals of 50 to 60 minutes produced comparable antidiuretic responses (Fig. 5). Tachyphylaxis resulted if shorter intervals were used. The lowest dose which had a significant antidiuretic effect was 3·5 microunits per 100 g. body weight. The highest dose with a discriminating effect was 50 microunits per 100 g. body weight.

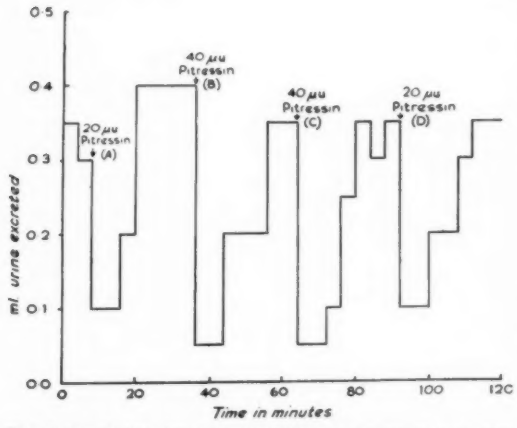


Fig. 5. Graph showing typical antidiuretic responses in a water loaded, alcohol anaesthetized rat. Antidiuretic effect: A = 60; B = 76.7; C = 80; D = 65.

The antidiuretic potency (a) was calculated from the equation

$$a = \frac{b}{a} \times 100$$

where:

a = number of drops of urine excreted in the 10 minutes between the eighth minute before to the third minute after the injection.

b = number of drops of urine excreted in the 10 minute period from the third to the thirteenth minute after injection.

British Pharmacopoeia, 1958

The method described by the British Pharmacopoeia 1958 for the assay of vasopressin is very similar to this one. Male rats are used, however, and the animals are given 3 ml. per 100 g. body weight of water, as the first water load. The second water load is 5 ml. per 100 g. body weight of 12 per cent ethanol solution, and is administered one hour after the first. The bladder and one jugular vein are cannulated one hour later, and a volume of water equal to the volume of urine excreted from the time the water was administered to the completion of the insertion of the catheter, is given by stomach tube. The experiment is carried out as described by Dicker (1953), with the rat being fed continuously with 2·5 per cent v/v ethanol to maintain the water load. Once the urine flow has become steady, injections of Standard Preparation are given intravenously until similar antidiuretic responses are obtained for equal doses. The antidiuretic effect is calculated from the expression:

$$\frac{10\,(a-b)}{a}$$

where:

a = the volume of urine excreted in the ten minutes lasting from the eighth minute before injection to the second minute after injection

b = the volume of urine excreted in the ten minutes elapsing from the second to the twelfth minute after injection.

Two dose levels of standard and two of unknown are used, the ratio of high dose to low dose being the same for each solution. The Pharmacopoeia 1958 suggests doses of 0·01 and 0·02 milliunits per 100 g. of body weight.

Ames and van Dyke, 1952

Ames and van Dyke also used a modification of the Jeffers, Livezey and Austin assay. The urethra in the ethanol and water-treated rats was ligated and a shortened urethral catheter was inserted through a cystostomy and firmly anchored by a ligature. Urine was then collected at five to 10 minute intervals directly from the bladder into specially designed 5 ml. cylinders, graduated to 0·05 ml. Injections were made intravenously through a 24 gauge needle which was inserted at a distance of 20 mm. into the saphenous vein. Estimations of antidiuretic activity were made by comparing the antidiuretic effect of the material to be assayed with that obtained from known amounts of vasopressin in the same rat. In all acceptable assays, 0·20 milliunits of vasopressin could be detected.

Ginsburg and Heller (1953)

Ginsburg and Heller found that variations in response to intravenous injections of vasopressin occurred with changes in depth of anaesthesia. They thus evolved a technique for using unanaesthetized rats in their assays.

Adult male albino rats of 180 to 230 g. were anaesthetized with ether, and a polythene cannula was inserted into the jugular vein. This cannula had been filled previously with heparin solution (10 units per ml. in 0·9 per cent sodium chloride). It was closed at one end with a removable cap. The cannula was brought under the skin and exteriorized through the skin between the ears. This prevented the rat from biting it out when it regained consciousness. The rats were then deprived of food and given two oral doses of tepid tap water (5 ml. per 100 g. body weight) one hour apart. Fifteen minutes after the second dose, the animals were made to empty their bladders by gentle prodding, and measurements of urine output were made at intervals of 10 minutes until the water load was between 6 and 9 per cent body weight and the urine flow was 1·5 ml. in 10 minutes. The assay was then carried out, each injection being followed by 0·2 ml. of the heparin solution. Further doses of water were administered subsequently to keep the water load and the uninhibited urine flow to within the prescribed limits.

Ginsburg and Brown (1956)

These workers introduced a modification of the Ginsburg and Heller method. The bladders of the rats were cannulated with polythene tubing and exteriorized between the ears beside the cannula from the jugular vein. Urine volumes were then measured at five minute intervals.

Discussion

In deciding on the method in an assay of this type, there are many factors to be considered. The ideal assay would be one which was accurate, reliable, short, easy to perform and with a high sensitivity. It is very difficult to find a method which will fulfil all these conditions, but some of those described in this paper are obviously more suitable than others.

The method of Boyd and Mack (1940) using frogs is not to be recommended, mainly because of the time entailed in carrying out the experiment, and it is very unwieldy because of the large numbers of frogs used.

Of the mouse assays the method of Heller and Blackmore (1952) is the most sensitive, antidiuresis being obtained with as little as 12·5 microunits per 100 g. body weight. On the other hand the fact that the volume of test material injected can only be about 0·05 ml. per 10 g. body weight puts this assay at a distinct disadvantage.

Rabbits are extremely difficult animals to use in vasopressin assays. They are very easily frightened and water loading alone is quite capable of inducing a very substantial antidiuresis. Reports of fairly high sensitivity to vasopressin in these animals have been made (Fugo and Aragon, 1947; Ginsburg and Heller, 1953) but there is so much difficulty in handling them in such a way as to prevent disturbance that other types of assay are usually preferred.

Dogs are very suitable animals for use in these assays. Sensitivity is usually about 0·2 milliunits (Samaan, 1935; Hare, Melville, Chambers and Hare, 1945; Ames, Moore and van Dyke, 1950). Ames, Moore and van Dyke found that it was possible to distinguish between 0·25 and 0·5 milliunits or between 0·5 and 1 milliunit, but they could not always distinguish between 0·75, and 0·5 milliunits or 0·75 and 1 milliunit.

One distinct advantage in using dogs is that large volumes of blood or urine can be injected intravenously, whereas with smaller animals the volume to be injected is severely limited.

These animals, however, must be trained to stand for long periods of time without moving.

The number of methods for assay for vasopressin using rats is very great. The animals are much easier to keep than dogs and the volume of extract which can be injected, while not large, is much greater than that which can be given to mice.

No matter which type of assay is being used, however, experimental conditions must be very strictly standardized. This, of course, applies to all types of vasopressin assay, regardless of the animal used. The size of rat is also important. Most workers used young adult rats of weight about 200 g. and in a paper by Dicker and Nunn (1958) it was stated that there was a great variability in antidiuretic response in old animals, following intravenous or intra-arterial injections of

vasopressin. It was noted that assays of antidiuretic activity in old animals were inaccurate and unreliable. The old rats also did not concentrate their urine to the same extent as young animals.

Male rats were recommended as being more reliable than females by Burn (1931), but since this statement was made several workers have used female animals and found their results to be very satisfactory (Dicker, 1953; McCreary, Adams, and Overman, 1957).

In both the Burn (1931) and the Jeffers, Livezey and Austin (1942) type of assay, the animals are deprived of food for several hours before the experiment. Burn (1931) found that this procedure gave him more accurate results, probably due to the fact that the water load is more uniformly absorbed if the stomach is empty. With the Burn type of assay, it is also very useful in that there is a decrease in the amount of faecal matter passed during the assay.

Uniform hydration is very important in these experiments. Most workers at present administer at least two or even three water loads in order to ensure this. It is most important that the water loading is carried out as quickly and as expertly as possible, as frightening the animal will cause antidiuresis. Ginsburg (1951) and Heller and Blackmore (1952) accustomed their animals to the procedure by administering water on several occasions before the assay.

One of the greatest difficulties in assays using rats is the fact that there is enormous variation in excretion rates from one animal to another. This can be obviated partly by rigid standardization of experimental conditions but this is not completely effective.

In assays of the Burn type, large numbers of 16 to 20 rats are used in each experiment in an attempt to cancel out this variation. With the Jeffers, Livezey and Austin method, however, this phenomenon is relatively unimportant as both standard and unknown solutions are assayed in the same rat. This, coupled with the fact that only one rat is being used instead of 20, gives this method an enormous advantage over the other. In addition, the intravenous route of injection used is much more reliable than the other routes used in the Burn assay. Absorption of fluids injected by subcutaneous and intramuscular routes is slow and irregular, whereas the antidiuretic activity manifests itself in two minutes after intravenous administration. Noble, Rinderknecht and Williams (1939) also noted that in some cases there was an apparent augmentation of antidiuretic effect when the subcutaneous route was used. They stated that this was probably due to delayed absorption from the injection site. They found that the most active substances in causing this were zinc, nickel, cadmium and ferrocyanide.

Variations of the Jeffers, Livezey and Austin method are the obvious choice if accurate measurements of antidiuretic activity are required. The route of injection is intravenous, thus giving reliable absorption; there is only one animal used; both standard and unknown solutions can be assayed in the same rat; the assay can be completed in three to four hours; and doses of the order of 20 microunits of vasopressin will produce an antidiuretic effect. The technique itself is not difficult, the problem being to produce a diuresis in the animal once it has been prepared. There are many factors, the causes of which are both known and unknown, which can render this experiment completely useless. To begin with, a good diuresis must be established before the cannulae are inserted into the jugular vein and bladder. If this operation is prolonged for more than 15 or 20 minutes, an irredeemable antidiuresis is very liable to occur. This can happen even if the required time is taken, due probably to the shock of the operation. The latter effect, however, sometimes wears off within about 30 minutes. Another factor which sometimes spoils the experiment is the water loading once the animal has been anaesthetized. The fluid is often aspirated into the lungs and nothing can be done to remedy this once it has occurred.

Thus, for random assays of antidiuretic material, the method described by the British Pharmacopoeia 1953 can be recommended, as the apparatus is easily procured and there are no techniques to be learned. For those with patience and determination, the several variations of the Jeffers, Livezey and Austin method are eminently preferable and ultimately rewarding.

Summary

1. A review of methods for assaying the antidiuretic hormone is given. These are concerned with the inhibition of water diuresis.

2. The animals used in these assays are dogs, frogs, rabbits, mice and rats.

3. A relative assessment of the methods described is given.

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Forthcoming Congresses and Conferences

Society for Applied Bacteriology

At the Summer Conference of the Society for Applied Bacteriology, to be held in London on July 7, 8 and 9, 1959, a Symposium will be held on 'Lactobacilli'. Those interested in attending, or contributing to, this Symposium may obtain more details from the Honorary Secretary, G. Sykes, Boots Pure Drug Co. Ltd., Microbiology Division, Standards Department, Nottingham.

PSYCHOLOGICAL ASPECTS OF LABORATORY WORK

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PART V—SOME WIDER HUMAN PROBLEMS (SECTION I)

Introduction

So far, only the briefest reference has been made to the wider human aspects of laboratory work. Most of the relevant observations were made in the first article in this series. The three previous articles have been concerned in their different ways with psychological aspects of measurement and the uses of measurements. The next three articles form a single unit dealing with those aspects of laboratory work which will conform more closely than the immediately previous ones with the layman's general conception of psychology. Various special methods of contemporary psychology are still applicable to the topics about to be considered. However, the discussion is now turning towards a general class of problems which do not necessarily have a unique solution. The following topics are included, among others, in those to be considered in the next three articles:

1. Age and achievement.
2. The effect of environmental conditions on human performance.
3. The role of individual differences.
4. Categories of research personnel.
5. Selection and training of laboratory personnel.
6. The assessment of human performance.
7. The evaluation of research.

At this point it must be re-emphasized that problems in applied psychology inevitably cut across several disciplines. In any case the boundaries between subjects (topics) are rarely as clear cut as they have to be made for purposes of academic discussion. The reader will find, therefore, that an appreciable proportion of the reference material quoted comes from authors who would not describe themselves as psychologists. Material which appears to be relevant, psychologically, has been sought out irrespective of its particular 'subject' label.

The present article consists of four main topics. The first topic consists of a review of the main activities which form the basis of laboratory work. The second topic is a discussion of available information about the variation of creative achievement with age. (For a general discussion of 'creativity' and its relevance to the research scientist *see* next article). The third topic consists of a review of relevant information about the effect of environmental conditions on human performance. The article ends with a discussion of some of the problems of developing recommended standards.

Major Activities in Laboratory Work

Two lists are presented here. It might have been advantageous to have presented these lists much earlier in this series for some of the items included have received detailed attention previously. The first list has been prepared by the writer on the basis of his own personal experience. The second list was prepared almost 10 years ago, although it has only recently come to hand for examination. To the writer, then, the major activities in the laboratory appear to be covered by the following list, which may be taken as the starting point for discussion:

List 1 (*Harper*)

1. Arranging specimens, supplies of raw materials, reagents, apparatus and equipment in accordance with efficient working methods.
2. Preparing specimens for testing in accordance with standardized practice.
3. Using apparatus, instruments and equipment for purposes of control, testing and measurement.
4. Reading dials, scales and other forms of indicator for a variety of purposes.
5. Operating (manual) controls which maintain selected conditions within prescribed limits.
6. Selecting and recording instrumental observations.
7. Preparing descriptive records of salient facts.
8. Planning, systematizing, computing and theorizing.
9. Developing new tests, apparatus and equipment in the light of information which emerges from investigations reported.

The second list was prepared by Flanagan and others (1949). It was based on a detailed analysis of information reporting outstandingly good or outstandingly poor performance among scientists in a moderate sized American research organization. Altogether over two thousand 'critical incidents' were assembled and analysed. The following 'major areas' emerged from a classification of these incidents:

List 2 (*Flanagan*)

1. Formulating problems and hypotheses.
2. Planning and designing investigations.
3. Conducting investigations.
4. Interpreting research results.
5. Preparing reports.
6. Administrating research projects.
7. Accepting personal responsibility.
8. Accepting organizational responsibility.

In general, there is a considerable amount of overlap between the two lists. The first is rather more detailed on some points, in spite of the second having been based on the observation of concrete situations. The last three items in the second list introduce an important range of new topics which are directly related to the

social problems of laboratory work (i.e. those arising from the interaction of two or more persons). Long as these two lists are, a number of important aspects of laboratory work remains which have not yet been discussed. Among these are the problems of age and achievement, and the effects of environmental conditions on human performance. These will be considered next.

Age and Achievement

It is generally believed that with increasing age creative achievement passes through a maximum and then declines. Myers (1941) referred specifically to the need for providing opportunities for changing the balance of personal commitments for most research workers as they grow older. Perhaps the most comprehensive factual study of 'Age and Achievement' is contained in a book with this title by Lehman (1953). Here he reviewed statistical data about creative output of various groups of persons throughout the span of life. Simplifying his data slightly, the figures given below indicate the age-range for the maximum creative output (in terms of publications) of several different scientific groups.

Subject	*Age-range for maximum creative achievement*
Chemistry	26—30
Mathematics, Physics and Electronics	30—35
Surgical techniques, Entomology and Psychology	30—40
Geology, Astronomy, Bacteriology, Physiology and Medical Discoveries	35—40

Lehman was fully aware of the limitations of such data, although this point cannot be elaborated here. The existence of the maxima and the indication of differences between different subjects are both of considerable interest.

Lehman listed some 15 'causes' of this apparent decline in creative output beyond a certain broad age-range. These included:

1. The decline in physical vigour and resistance to fatigue which normally takes place *before* the age of 40.
2. Older persons are apt to become more preoccupied with the task of earning a living and getting ahead.
3. Success and promotion, which often come with increasing age, frequently result in less favourable conditions for sustained and concentrated work (of the type which leads to publication).

For the sake of completeness it should be noted here that Lehman indicated that there was no evidence of any similar early decline in performance of top-level executives and leaders. A more recent study of the performance of a scientific group has been summarized by Peters in a chapter entitled 'Human factors in research administration' contained in a UNESCO publication edited by Likert and Hayes (1957). The creative accomplishments of some 4,000 American physiologists were reviewed. The number of citations in the technical literature was taken as a better index of creative output than number of publications alone. The data were collected in such a way that it was possible to break down the various influences under relevant sub-headings. In particular, it should be noted that whereas the general picture was similar to that reported by Lehman, certain individuals, who had strong motivation, coupled with good opportunities for research, showed no decline in creative output of the type still indicated by the general trends.

General Observations on the Effect of Environmental Conditions

The effect of environmental conditions on human performance is the concern of many different specialist groups. Certain aspects, such as illuminating engineering, or heating and ventilation engineering, tend to be broken off as separate specialist fields of applied science and technology. There is every prospect of these subdivisions increasing in number, although this increased specialization tends too readily to establish provisional views as technological orthodoxy. Quite clearly, the physiologist has a major interest in the impact of the external environment on the functioning of the human organism. Equally, however, the behavioural aspects come within the legitimate scope of the work of the applied psychologist. Industrial psychologists were among the pioneers who worked upon the general problems of lighting, heating and ventilation, as well as those of work layout and design. This fact is made abundantly clear by reference to any text book of industrial psychology, e.g. Myers 1929, Viteles 1932, May Smith 1943. (The dates refer to first editions of books which have been reprinted.) Comparatively few published investigations deal explicitly with the effect of the laboratory environment, although this state of affairs is beginning to change. In general there are at least two major problems:

1. The development of recommended standards for comfort and efficiency.
2. The establishment of the extreme limits under which performance actually breaks down.

In the past, critical or extreme limits have rarely been a matter for consideration in any but special service laboratories. However, with the prospect of an extension of laboratory work to arctic and tropical conditions the determination of such limits may become of practical importance. For example, press reports recently referred to proposals for some 5,000 technical personnel distributed at 180 stations throughout the world for the purpose of detecting nuclear explosions. Among the important work dealing with human tolerance limits the reader may consult a report by Mackworth (1950, pp. 120-143) in which he has indicated the critical upper limit to the 'effective temperature' (a response-index combining temperature, humidity and air speed)

above which all types of human performance begin to break down. There were, as usual, important individual differences in response, and the tolerance limits for the most skilled performers were greater than those for the least skilled.

Some interesting developments on lighting have recently been reported by Hopkinson in a symposium (1958) organized by the Institute of Physics on the design of physics research laboratories. The work concerned is being carried out jointly by the Building Research Station and the Department of Architectural Studies of the Nuffield Foundation. In particular, Hopkinson referred to a design for the single side-lit laboratory, based upon the determination of the minimum levels of natural and artificial lighting required for efficient performance in laboratory work. This implies that standards have in fact been laid down for work of this type. Further information on this point is given by Musgrove and Petherbridge (1957), in a paper which outlined a new approach to the specification of lighting requirements in terms of the *amount of time* spent on various types of visual tasks. Previous recommendations have been based largely on size of detail and contrast-ratios in the visual task concerned. The new development is another example of a revised method of approach to an applied problem for which recommended standards are already in existence.

Only a brief comment will be made here about the effects of noise on human performance, with special reference to laboratory work. This is another field in which, at least in matters of detail, views are changing as new data emerge. Evidence about the effects of noise has been rather conflicting, as the important critical review by Kryter (1950) indicated. There are at least three major aspects of immediate interest. These are:

1. The distracting influence of intermittent or occasional noises.
2. The effect on performance of prolonged exposure to noise of high intensity.
3. The possible deafening effect of prolonged exposure to high intensity components.

Normal loss of hearing sensitivity with increasing age complicates this last item. However, as the deafening effect of noise is likely to be restricted to special purpose laboratories (e.g. those concerned with work on turbines and aero-engines) this last item will not be considered further in this review. There have been frequent *claims* about the impairment of precision operations and refined judgments by intermittent noise. Thus Crocker (1945, p. 86) referred to the impairment of 'taste testing' by loud noises. The writer has noted elsewhere the *impression* of loss of sensitivity in making judgments involving fine discrimination but supporting quantitative data are lacking. Broadbent (1957) has recently summarized new experimental data concerned with the effects of continuous noise. The general impression emerged that noises which do not form an integral part of the task in hand certainly impair performance. (*See also* Broadbent, 1953, for additional data concerning the effect of noise on the 'vigilance' type of task). However, different levels of noise could only be distinguished when the effects of noise of quite high intensities (100 decibels) were contrasted with those of moderate intensity noise (80-90 decibels). Combinations of high frequency with high intensity noise were particularly undesirable. Another interesting feature emerged from this investigation, in which the subjects were naval ratings under the age of 30. Two separate groups of subjects were given tests (of the hand-eye coordination type) with a background noise at two frequency levels but with a fixed intensity level of 100 decibels. For the first group the high frequency noise was presented first, followed by the low frequency; the conditions for the second group were reversed in order. Table II clarifies these points of design; a comparative indication of the number of errors in the two situations is given in brackets.

TABLE II

(Adapted from Broadbent, 1957)

	1st Test	*2nd Test*	
Group 1	HF (75)	LF (32)	*Worst conditions first*
Group 2	LF (24)	HF (24)	*Worst conditions last*

HF—*High frequency noise*
LF—*Low frequency noise*
Intensity—both instances—100 db.

It is evident from the number of errors indicated that exposure to the unfavourable conditions in the first test predisposed this group to perform badly in the second test in spite of the improved conditions. Important individual differences in susceptibility to noise were also noted in these studies.

Individual differences are particularly important when it comes to dealing with the irritating effects of noise. Here one may usefully note some general observations by May Smith (1943, pp. 61-68) in which she indicated that the definition of noise as an unpleasant sound means unpleasant to the speaker. A noise is not a noise if it is made by ourselves; it is generally other people who make noises. It is also curious to note that the literature on noise is very much more emotional than that on temperature or illumination. People of a nervous temperament are much more susceptible to noise. For this reason she suggested that they may serve as an index of something wrong, even though more stable persons may be indifferent to it.

On Developing Recommended Standards

From a methodological point of view the development of recommended standards is an exercise in applied psychophysics. It involves all the problems of systematizing stimulus-response characteristics which have been touched upon in an earlier article. Strictly speaking a distinction is desirable between the requirements of comfort and those of efficiency. The existence of individual differences makes it unlikely that prescribed standards will prove readily acceptable to more than

about 80 per cent of those concerned, this figure being regarded as at the upper end of the probable range. Important occupational differences in requirements are common, and there may be national (and possibly regional) differences in prescribed standards for identical work. Thus, for example, reference to various handbooks and other major source material will reveal that American standards for lighting and heating are somewhat higher in their demands than our own. (There also appears to be a systematic difference between the magnitude of the 'just audible sound' based on extensive surveys in the two countris. The difference indicates a slightly higher apparent sensitivity in the U.K. Group).

Changes in prescribed standards with the passage of time must also be noted. Examples of this type have already been included above. Some are simply due to new technical and scientific advances but developments which may be compared with the continuously increasing human demands characteristic of a rising standard of living, cannot be ignored. Few of us today would be satisfied in our libraries with the 'dim religious light' of the scholar's cell of earlier times. Whether 'improved' conditions actually result in improved performance, unless the former are simply defined by the latter, is always a complicated question to decide. Some of the difficulties in the way of studies of this type have already been noted in passing, including the fact that the presentation of two variable conditions in order AB may produce a response different from that produced by order BA. This obviously complicates the analysis of results and their application. It is also well known that individuals who are made the subject of special investigations *may* apply themselves more assiduously to the task in hand and so give false or atypical result. One of the earliest indications of this fact arose in a supposedly physical study of the effects of changing levels of illumination on performance in simple, electrical assembly tasks. In this particular study, carried out at the Hawthorne Works, of the Western Electric Company of Chicago between 1924 and 1926, no appreciable difference could be detected between the performance of a control group, working in unchanging conditions of illumination, and that of an experimental group working under varying conditions of illumination. One group maintained its level of performance even when the illumination was reduced to that of about full moon light. (*See* brief review in Urwich and Brech, 1948, pp. 14-15). These results obviously conflict with the logic of a straightforward physical experiment and indicate some of the hazards of experimenting on human performance. Present-day techniques are more sophisticated, psychologically, than they could have been in the mid-twenties, but many problems, especially those involved in the choice of an appropriate group of responding persons still remain.

NOTE.—References to this section will follow at the end of Article VII.

(*To be continued*)

Human Sciences in Industry

The D.S.I.R. Human Sciences Committee—which was formed in 1957 to take the place of the former D.S.I.R.-M.R.C. Committees on Human Relations and Individual Efficiency in Industry—will continue to support research in psychology, sociology and allied fields, such as industrial administration and operational research.

Now that all the research will be financed by government funds, it will be possible to support both basic and applied research, rather than applied research only, as tended to be the case when using funds from United States Counterpart Aid. The Human Sciences Committee considers that it is important to encourage both basic and applied research in order to promote the growth of psychology and sociology and to make further contributions to the solution of the practical problems of industry and society. It must be realized that psychology and sociology are at a relatively early stage of development and do not have a sufficient background of theory and facts to deal with practical problems on a scale approaching that in the physical sciences.

The Human Sciences Committee are taking up proposals for research on a relatively large scale from certain well-established research groups which between them cover the whole field from experimental psychology to sociology. Thus, it is hoped that groups will exist capable of developing a co-ordinated programme of research rather than relying on two or three year projects. Ordinary short-term projects are still being supported and so far the Committee have approved applications for research on such topics as: reading efficiency, inspection, the management of technical change and innovation, and the problems of the transition from school to work.

It is anticipated that even when a substantial number of grants have been awarded to the universities and other research bodies, there will remain topics on which insufficient or no research is being conducted. So the Department is conducting a survey of research needs, from the point of view of both industrial problems and the development of psychology and sociology. The first of these surveys was of the effect of automation and higher mechanization on the operative's job and its effects on organization of the working group and the consequent needs for research. The research team have already submitted to the Department their draft report, which may be published in popular form.

The dissemination of results of research is a matter of considerable importance, particularly those results which have an industrial application. The Department hopes, therefore, to continue the publication of industrial versions of reports and the publication of articles in engineering and other technical journals. In addition, new ways of 'marketing' the results of research are being considered.

The recommendations of the former D.S.I.R.—M.R.C. committees (see *Laboratory Practice*, **7**, 662) have been considered by the Committee and steps have already been taken to implement some of these proposals. The D.S.I.R. is not empowered to act on all the recommendations. Some concern other Government departments and others, like the need for more senior posts in the universities, are matters solely for the universities.

The recommendation of the Individual Efficiency Committee that engineers should know more of the principles of anatomy, physiology and psychology as applied to equipment design (covered by the term ergonomics) has been met in part by the establishment of some one or two week courses for engineers in ergonomics. It is likely that such subjects will be included in some of the engineering courses at universities and technical colleges.

The Committee intends to encourage the universities and industry to support more research and applications of the human sciences. This can best be done by sponsoring researches of a high quality which will inspire industry and the universities to use their own resources to carry out further work in this field.

FOOD ANALYSIS-TECHNIQUES, INTERPRETATION AND LEGAL ASPECTS

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PART X—TRACE ELEMENTS IN FOOD

Summary

This article is concerned with the general considerations relating to the more important 'toxic' trace elements which occur in foods, e.g. their occurrence, classification, legislation, preparation of the solution prior to quantitative determinations by dry and wet methods, the types of methods used and the use of reagents such as diphenylthiocarbazone for separating metals and determining them. The next article in the series will discuss the determination of individual elements.

Sources

Trace metals arise normally in foods from one of the following sources:

(*a*) Natural occurrence, e.g. uptake by plants from the soil, deposition in the liver of animals, natural presence of high amounts in fish (especially shellfish).

(*b*) Sprays and insecticides used during cultivation.

(*c*) By contact with equipment or utensils made from unsuitable materials, e.g. galvanized iron, tinplate (due to unsatisfactory canning techniques), cadmium plating, solders, enamels, glazes.

Attack on the materials mentioned in (*c*) is usually encouraged by the presence of acid (fruit and soft drinks), alcohol (beer, cider and wine) or salt (pickles and sauces). Nowadays the materials used for new plant are usually either aluminium, stainless steel, Monel metal or Inconel metal (both the latter materials contain nickel). Such materials are obtainable in various grades so that a suitable metal can be chosen for a particular process. Consideration of the chemical and physical properties of copper suggests that it is also suitable for food equipment but due to economic reasons coupled with its unpopularity with the health authorities, the element is being used less now than formerly.

Classifications

Classification of trace elements is somewhat difficult as many of the elements which are harmful if ingested in large amounts are necessary for normal metabolism in smaller quantities. Calvery (1942) suggested that a trace element rarely exceeds 20 p.p.m. in foods and broadly classified them in relation to their physiological effects:

1. The *nutritive elements* which are definitely essential for human metabolism, e.g. cobalt, copper, iron, iodine, manganese and zinc.
2. The *non-nutritive non-toxic elements* which are not necessary for man nutritionally and do not appear to have harmful effects when present in food in quantities up to 100 p.p.m., e.g. aluminium, beryllium, boron, chromium, nickel, silicon, strontium, tin and titanium.
3. The *non-nutritive toxic elements* which are not nutritive and are known to have harmful effects even if the food contains less than 100 p.p.m., e.g. arsenic, antimony, barium, bismuth, bromine, cadmium, fluorine, lead, mercury, molbydenum, selenium, silver, tellurium, thallium and vanadium.

Toxicity

Most instances of metallic poisoning reported in the literature (Monier-Williams, 1950; Tanner and Tanner, 1953) relate to a comparatively rapid onset of symptoms (acute poisoning), viz. emesis (vomiting) due to the ingestion of comparatively large amounts of such elements as copper, cadmium, zinc and antimony, present in acid foods prepared in unsuitable equipment. Reported instances of cumulative poisoning due to small amounts ingested continually from food over a period (chronic poisoning) are rare.

Apart from the effect on the body, however, some metals cause a deterioration in quality or nutritive properties of the food, e.g. copper may cause losses of vitamin C in vegetables or off-flavours in milk and dairy products.

Legislation: Recommended Limits

Prior to World War II no *statutory limits* for trace elements in food had been prescribed, but a few limits had been *recommended* either officially or unofficially, e.g. general limits for arsenic (1903) and for tin (1908), for lead in acidic baking ingredients (1907) and in canned sardines (1933, 1937) and for copper in tomato purée (1938). In recent years statutory limits for certain trace metals in gelatine, tomato sauce and curry powder have been *prescribed* and general and specific limits have been *recommended* for the main toxic trace elements by the Food Standards Committee's Metallic Contamination Sub-Committee. In addition, The Fluorine in Food Order was introduced in 1947.

The statutory and recommended limits are far below the amounts required to produce toxic effects when normal quantities of the food are eaten (cf Williams, 1958), but in a few instances (e.g. lead and arsenic) the cumulative nature of the poison makes it important to keep the intake as low as possible. Apart from such

considerations the comparatively low limits encourage clean, efficient processing methods.

The Committee suggests that the comparatively high amounts of trace metals which sometimes occur naturally in shell fish, offals etc., should in general be permitted.

Preparation of Foods prior to the Determination of Trace Elements

It is possible with some readily soluble food materials such as salt, sodium bicarbonate, cream of tartar, tartaric acid and sugar to prepare the solution prior to the determination of trace metals by simply dissolving the material in water or cold acid (e.g. B.P. rapid methods for arsenic and lead). With most foods however it is necessary to destroy organic matter, etc., either by dry ashing or wet oxidation.

Dry ashing is the simplest method of destroying organic matter. Middleton and Stuckey (1953) have critically reviewed the subject and point out that the dry ashing of biological materials is liable to lead to low results due to:

(*a*) Volatilization of some of the element due to too high a temperature of ashing being used.

(*b*) Absorption or combination of trace metals with other ash constituents or with the ashing vessel.

(*c*) Incomplete extraction of the residue with acid after ashing due mainly to the formation during ashing of acid-insoluble substances.

In view of possible volatilization it is necessary to vary the ashing temperature in relation to the particular element being determined and it is therefore important to use a muffle furnace with sensitive temperature control. The range 500°-550°C. appears to be satisfactory for most elements, but arsenic and lead tend to be partially lost by volatilization at such temperatures unless an 'ash-aid' is used.

The commonest ash-aids are the nitrates, oxides or acetates of magnesium or calcium, aluminium nitrate and sulphuric acid (sulphated ash) and these substances also assist complete extraction of the ash as they tend to prevent the formation of acid-insoluble substances. Ash-aids must be rendered free from the element to be determined before use. Extraction of inorganic substances can also be assisted by moistening the ash with nitric acid and then re-igniting.

Although dry ashing is apparently unsatisfactory if the highest accuracy is required, in practice its simplicity renders it suitable for routine determinations of many trace elements as the constant vigilance necessary with the 'classical' nitric-sulphuric acid wet oxidation method represents a definite disadvantage in busy laboratories.

Wet oxidation methods for destroying organic matter have also been critically reviewed in Middleton and Stuckey's (1953) paper. Usually sulphuric and nitric acids are employed but other oxidizing agents (particularly perchloric acid) and the addition of substances to raise the boiling point (e.g. potassium or sodium sulphate) have also been proposed. The commonest procedure is firstly to boil the sample with nitric acid in a Kjeldahl digestion flask, then to add the sulphuric acid and continue the boiling until oxidation is complete, adding further quantities of nitric acid immediately the liquid darkens (B.S.757:1944, p. 30). Especially when the amount of organic matter is small both acids can be added to the sample at the beginning. It is advisable with either method to heat the liquid for some time after the last addition of nitric acid and to heat for a further period with ammonium oxalate (or perchloric acid), which assists in removing the yellow colour due to nitro compounds, fats, etc. The main disadvantages of the classical methods of wet ashing are the constant vigilance required and the possibility of high blanks due to reagents, which tends to be aggravated by the fact that large volumes of the nitric acid are lost as vapour without playing a part in the oxidation.

A *'cold' wet oxidation method* was subsequently proposed by Middleton and Stuckey (1954) which has a number of advantages over the older procedures particularly for animal products and fatty materials. The authors claim that at the temperature used ($\leqslant$350°C.) losses due to volatilization are diminished, the nitric acid is used much more efficiently and the process requires little attention. For the process the material ($\leqslant$5 g. dry matter) is heated with 10-20 ml. water and 5-10 ml. of nitric acid (s.g. 1·4 and containing 5 per cent sulphuric acid) in a litre beaker (uncovered) on a hot-plate maintained at 310°-350°C. The temperature can be checked by placing on the hot plate substances of suitable m.pt., e.g. potassium nitriate (334°C.) and frothing is controlled by the addition of capryl alcohol. The mixture is evaporated and treated further with successive quantities of nitric acid (sufficient to moisten the residue) after covering with a clock-glass. For each treatment the residue is allowed to remain on the hot-plate for 15 minutes after it goes dry and the nitric acid is added after allowing to cool. Fuming nitric acid is then used to produce a white residue, which can be brought into solution by heating with dilute sulphuric acid. A blank determination can be easily carried out by evaporating an equal volume of nitric acid to that used for the sample (only a small amount is required compared with the conventional method). The authors suggest that in certain circumstances (*a*) the first nitric acid treatment may be carried out without the addition of water or sulphuric acid, (*b*) fuming acid should be used earlier and (*c*) the final residue can be brought into solution with alkali before acidifying.

Types of Analytical Methods and Reagents Employed

The methods of general chemical analysis are all used for determining trace elements. Photometric methods (absorptiometry, spectrophotometry, nephelometry and fluorimetry) and visual colorimetric methods are more convenient for the determination of most trace elements in foods, but volumetric and even gravimetric micro

methods are occasionally sensitive enough. Spectrography can be employed for any element but, due to the difficulty of measurement, the method tends to give inaccurate results (Sandell, 1950). Polarography is now being increasingly used, particularly in laboratories where a large number of determinations are made frequently on a restricted number of elements.

For most determinations it is necessary to prevent interference by other metals by treatment of the solution of the food by the addition of reagents or by electrolysis. Occasionally the treatment with reagents can be made in the final solution, e.g. in the sulphide colorimetric estimation of lead, cyanide is added as complexing agent for copper, and ammonium citrate is used to prevent the precipitation of phosphate and the coloration due to iron. It is more usual, however, to use organic complexing agents at an earlier stage for separating out the interfering agents. Some of these reagents give coloured complexes and are also suitable for the determination of metals, e.g. dithizone and certain diethyl-dithio-carbamates.

Diphenylthiocarbazone (dithizone), $S=C<^{NH\text{-}NH\text{-}C_6H_5}_{N=N\text{-}C_6H_5}$

is particularly important in this connection. It is a purple-black powder which is insoluble in water and is usually used as a solution in chloroform (solubility 2g./100 ml.) and carbon tetrachloride (solubility 0·05g./100 ml.). Solutions of dithizone are usually green, but concentrated solutions are red in transmitted light. When a heavy metal (other than a tervalent metal) in aqueous *ammoniacal* solution is shaken with dithizone in chloroform solution, coloured dithizone complexes are formed which remain in solution in the chloroform layer. For separations use is made of the fact that a more restricted number of metals are extracted under acid conditions or after the addition of substances which 'hold back' other metals. Potassium cyanide is useful in this connection as it causes transference to the aqueous ammoniacal phase and also forms complexes with interfering metals. Care is necessary however as dithizone is somewhat prone to oxidation in alkaline cyanide medium particularly by ferric or cupric compounds. The oxidation can, however, be prevented by the addition of reducing agents.

After separation the metal can be estimated (using dithizone) by the mono- or di-colour methods or by titration or the reversion technique. In the *mono-colour* method the metal is extracted completely from the aqueous solution using excess of dithizone solution. Excess reagent is removed from the chloroform layer by shaking with ammonium hydroxide or ammoniacal cyanide and the intensity of the colour of the organic layer due to the metal is measured. The method tends to give erroneous results however due to incomplete extraction, formation of enol complexes or decomposition of the dithizonate. In the more accurate *di-colour* method the excess dithizone is not removed so that the colour of the organic layer is due to a mixture of tints (dithizonate + dithizone itself) and this can be measured by spectrophotometry or by comparison with standards containing the same amount of dithizone.

Another quantitative dithizone method is the *extractive titration* procedure in which an aqueous solution of the metal is titrated in a separator with a standardized dithizone solution. The metal dithizonate is drawn off until the added reagent remains green after shaking. A further titration method has been described by Hibbard (1937, 1938).

Irving and his collaborators (1948, 1949, 1953) have developed the *reversion technique* for the determination of trace metals in which a mixture of dithizone and metal dithizonate in an organic solvent is shaken with an aqueous solution of a reagent which forms a stable complex with the metal. The metal returns to the aqueous layer and an equivalent amount of dithizone is liberated in the organic layer. The change in optical density so produced is proportional to the concentration of the metal present. The reversion procedure eliminates a number of the difficulties which are possible with other methods and no standard dithizone solution is required. For further information on these and other methods and reagents reference should be made to Sandell (1950), H. & W. (1955) and B.D.H. (1958).

Practical Rules for Trace Element Determinations

1. When dry ashing is employed for the destruction of organic matter accurate control of temperature is essential.

2. Time can be saved in most trace element determinations by weighing out the sample *as accurately as possible* on a good *rough balance*.

3. Use good quality glassware, etc., so that the uptake of elements from the vessels is as small as possible.

4. All vessels used must be scrupulously clean, e.g. all Nessler glasses must be rinsed out with *distilled water* just prior to use. Tap water may contain elements such as iron and traces of lead are present in dust.

5. The purest possible reagents must be used, e.g. PbT and AsT qualities.

6. When 'unusual' results are obtained it is advisable to repeat the determination using a different method.

(*To be continued*)

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THE DROP TECHNIQUE FOR COLONY COUNTS IN MICROBIOLOGY

by J. G. Davis and Jean S. Bell

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ALL methods of estimating colony counts involve adding a known volume of a suspension to a medium, incubating for a specified time and then counting the colonies. The three basic methods of measuring the volume are with volumetric pipettes, dropping pipettes and calibrated loops. If the last is used the volume of sample is very small. A convenient, durable type of dropping pipette has been described elsewhere (Davis and Bell, 1959). The purpose of this paper is to describe the methods of use with, and the advantages and disadvantages of various types of dropping pipette.

Historical

In early work involving colony counts dropping pipettes were preferred by Ficker (1898), Lane-Claypon (1909), Chick (1912) and Penfold (1914). A technique for using dropping pipettes was described by Donald (1915) and this was used by Wilson (1922), but for the calibration Wilson used Imperial Standard wire gauge No. 22 and a screw micrometer measuring to 0·01 mm. The pipettes were calibrated gravimetrically. Experiments were made to determine if the number of organisms present affected the size of the drop, but no appreciable differences were found in drop values from 500 million to 10,000 million organisms per ml. No significant differences were obtained between successive drops. Wilson recommended that not less than four drops should be used for each sample, and found that the error was then not greater than 1·2 per cent. For serial dilutions separate pipettes should be used for each, and the error was then less than 3 per cent. Wilson also emphasized that the dropping pipettes should be kept clean, otherwise there was a tendency for the bacteria to cling to the sides of the pipettes and an error of greater than 1 per cent could be introduced.

Miles and Misra (1938) described a technique in which one drop from a pipette delivering 0·02 ml. was allowed to fall on a sector of each of six plates. From six to eight dilutions were prepared using 0·1 ml. suspension and 0·9 ml. volumes of diluent. These authors recommended drying for not more than two hours with lids raised after incubation of the poured plates for 24 hours at 37°C. with the lids closed. They found that such drops from a height of 2·5 cm. spread over an area of 1·5 to 2·0 cm. diameter. The number of colonies in countable areas varied from 20 to 100 according to the size of the colony.

Pomales-Lebrón and Fernández (1952) described a method in which volumes of from 0·01 to 0·1 ml. were added to 12 ml. of agar medium in a plate using a 0·2 ml. pipette. They found it necessary to dry off the plates before use. A standard procedure was to incubate for 24 hours and then to refrigerate them until required (up to one week). The plates were then incubated for two hours at 35°C. with the lids slightly raised. For one purpose 0·02 ml. of a dilution was added to a 1/6th sector of duplicate plates, and for another 0·02 ml. added to alternate 1/10th sectors of a plate (i.e. 0·1 ml. of the dilution in all). The method was claimed to be more economical in time and materials, to be almost free from spreading growths, to be less liable to errors in counting, to be less liable to contamination, and to avoid the possible harmful effects of hot agar on certain bacteria.

Mallman and Broitman (1956) used this technique with certain modifications for milk. Plates were incubated for four hours before use as it was found that incubation for less than three hours led to confluence of colonies. No advantage was gained by a longer incubation. To avoid a concentration of milk solids at the periphery of the spread drop these workers used a 1 in 20,000 Triton X-100 (non-ionic wetting agent) buffered saline solution as a diluent. This gave a 'drop area' nearly 30 per cent greater than without the Triton X-100, and in addition resulted in a more even distribution of colonies. The plates were divided into four quadrants and 0·1 ml. of diluent added to each quadrant using a 0·2 ml. pipette which was allowed to touch the agar while the drop was discharging. The plates were not moved for at least one hour and then incubated right side up at 35°C. The colonies were counted after 36-48 hours.

Advantages of Surface Culture

In addition to the advantages mentioned above, all surface culture methods, whether using a dropping pipette or a loop, have certain advantages over pour-plate methods. Thus, most organisms are aerobic or facultatively anaerobic and therefore form larger colonies on the surface than in the depth. Obligate aerobes which may be in the depth of the agar in the pouring method may fail to grow or only form pin-point colonies. Other things being equal, therefore, counting is easier with a surface method. Moreover, surface colonies are more characteristic for identification purposes and this is a useful property whether one is dealing with pure or mixed cultures.

Types of Dropping Pipette

(*a*) *The classical Pasteur type.*—A few months ago we were confronted with a scheme of work which involved

making a large number or colony counts at frequent intervals. In a discussion of the work with Dr. Ella Barnes she drew our attention to the advantages of the drop method. The classical Pasteur pipette with the tip calibrated in a No. 54 gauge hole was suggested. The economy of the method was obvious, but the fragility of the tip of the glass pipette was clearly the biggest disadvantage of this technique. Each pipette could be used only once; it then had to be cleaned and re-sterilized. This aspect involved considerable labour if a large number of samples was to be examined, and wastage was high because the tips were so fragile.

(*b*) *The hypodermic needle type.*—In an effort to overcome the breakage aspect Mr. Arthur Rowlands submitted a pipette formed by grinding a glass stem into the top of a hypodermic needle which had been cut off square. Although the needle functioned well it tended to fall off the glass stem. The latter also sometimes cracked during sterilization. This type was therefore abandoned, but if anyone could devise methods for overcoming these two faults there is no reason why this type of pipette should not work satisfactorily.

(*c*) *The platinum tube type.*—Shortly after this Mr. W. H. Pierce kindly sent us a pipette consisting of a short length of platinum tubing sealed into a bulb pipette. Trials with this showed it to be a most useful tool and we adopted it for the investigation. In view of the expense of platinum we examined the possibility of using a substitute metal. Two firms sent us samples of the correct size tubing in certain metals, and Mr. Arthur Rowlands prepared pipettes using these materials. Although these pipettes worked satisfactorily it was found that they cracked after a short period of use. Further, a cost investigation showed very clearly that the expense of the platinum tubing was relatively small compared with the cost of making the pipette. There is, therefore, no great point in striving for a cheaper metal. Another point to bear in mind is that if the pipette cracks the piece of platinum tubing can be sealed into another glass bulb pipette.

Description of Pipette

The platinum tube pipette consists of a $\frac{1}{2}$ in. length of platinum tubing of 0·9 mm. outside diameter sealed into a bulb pipette and operated by a teat. The tube must be cut off very precisely and square, and the top must be flush with the inside surface of the bulb. These points should always be emphasized to manufacturers. The angle of the tube is a matter of personal preference. Some workers prefer 45° but we prefer the tube to be slightly closer to the line of the pipette.

The pipettes must be calibrated with the solution to be used, e.g. one quarter strength Ringer solution. The size of the drop is given by the formula

$$V = \frac{2 \pi r \sigma}{dg \varnothing}$$

where V = volume of drop, r = radius of tip, σ = surface tension of liquid, d = density of liquid, g = acceleration due to gravity and $\varnothing$ = correction factor for neck of drop.

Special calibration must always be made if the solution contains any detergent or other substance affecting surface tension. The volume of the drop varies directly with the outside diameter of the tube and with the surface tension of the liquid. The pipettes may be calibrated by allowing a known number of drops, e.g. 20, of quarter strength Ringer solution or other liquid to fall slowly into a flask or beaker of known weight and immediately re-weighing. We have found the drops to have an average volume of 0·018 ml. With careful use of a single pipette the error is 0·001 ml. or $\pm$ 5 per cent. Pipettes may vary slightly and if an accuracy of $\pm$ 5 per cent is aimed at, they should be calibrated individually and either adjusted or put in groups having slightly different factors. The factor must be calculated according to the average volume of the drops. A useful device is to prepare a table which gives counts per ml. corresponding to drop counts. Results can then be read from this table and a slide rule is unnecessary. The method may not be quite as accurate as the orthodox pipette method, but the error of the colony count is so high that the difference between the two techniques is relatively small. We were concerned with a large scale investigation where the primary interest was the logarithmic increase in numbers of bacteria and the work was essentially of a comparative nature. For such purposes the drop technique is invaluable. Where the highest possible accuracy is required either multiple drops or the 1 ml. pipette method should be used.

Method of Use

All pipettes are fitted with rubber teats. At least six pipettes should be cleaned and stood in a row in a beaker containing 70 per cent alcohol or 75 per cent methylated spirit. The pipette on the left is taken, the alcohol squeezed out and the pipette flamed. About five seconds is required for the alcohol to burn off and then, after a pause of two to three seconds, the pipette is used, starting at the highest dilution. When all dilutions have been 'plated' the pipette is rinsed in water if necessary and then returned to the right end of the row of pipettes in the beaker. Each pipette should be immersed in the alcohol for at least 15 minutes before re-use. This is necessary because it ensures a thorough rinsing and sterilization of the pipette, and also helps to prevent cracking. If the pipette is heated successively at intervals of only three minutes it will tend to crack, but if the flaming treatment takes place only at intervals of 15 minutes or greater, breakages are rare.

After using dropping pipettes for a considerable number of tests, we have found that the most efficient method of manipulating the pipette is to hold the stem between the second and forefinger with the teat between the thumb and the base of the forefinger. After squeezing out the alcohol the pipette is 'burnt off' and then the highest dilution sucked up by squeezing and then releasing the teat. The pipette is held vertically over a

marked sector of a poured agar plate, and a drop allowed to form as slowly as possible and then fall on to the agar from a height of about 2 cm. The residual diluent is rejected and the next dilution treated similarly. One pipette may be used for a series of dilutions without flaming, etc. It is normally convenient to add single drops of four consecutive dilutions to the four quarters of one plate. The drops are spread over the sector by a bent wire, leaving a margin between sectors. The wire is finally 'wiped off' on the edge of the sector. If the suspension is of low count five drops may be allowed to fall on half the plate, and single drops of the original suspension and first dilution added to quarters. This method will increase the chances of getting a suitable number of colonies to count without involving the use of an extra plate. For very low counts ten drops can be added to a whole plate.

Comparisons between spreading and not spreading the drops have shown that colonies are sometimes uncountable when the drop is not spread but are countable when the drop is spread.

Tests for the efficiency of sterilizing treatment can be made in the usual way. In practice this is done automatically by failing to obtain colonies in those sectors which, in relation to other sectors, should give no colonies. If sterile sectors are not obtained in these circumstances it can be taken as an indication that the pipettes may not be sterile, and suitable check tests made.

After use, the pipettes should be rinsed out in hot water and left soaking in 0·5 per cent Teepol overnight. They are then rinsed thoroughly and left in tap water for a few minutes before placing in a beaker of 70 per cent alcohol ready for use. Sterilization in a hot air oven is unnecessary.

Preparation of Plates

When large numbers of samples are to be examined it is very convenient to pour the plates the day before the tests are made. The agar should be cooled to about 48°C. in order to avoid 'steaming' and subsequent condensation. We did not find it necessary to dry the plates in the incubator, but it is advisable to invert the plates on the bench overnight. Plates of acid media (e.g. at pH 3·5) can be poured direct from the flask. This method not only saves labour and the use of test tubes, but eliminates further heating of the medium. Presumably the same could be done with all media by using an efficient aseptic technique. For routine count purposes an occasional contaminant is not an important matter. Although we found it convenient to pour plates on one day and use them 18 hours later, a longer period should not be used otherwise excessive drying may occur. This is obviously more serious in hot weather. A dried-up agar will not absorb water readily and so one may obtain confluence of growth.

The bottom of each plate should be divided into sectors with a grease pencil, and a mark made to identify the highest dilution. Up to six dilutions may be dropped on to one plate if necessary.

Economic Aspects

One of the main reasons for adopting the drop method for the investigation on which we were engaged was the economic aspect. If the ordinary plating method had been used we should have needed about 1,200 plates and tubes of agar every two to three days, and in addition considerable incubator space. By using the drop method these requirements were reduced to 300 plates and tubes of agar, and a quarter of the incubator space. The greater the number of dilutions to be plated, the greater is the economy effected. There is not only a great saving in initial expenditure but also in washing up, and cleaning and sterilizing the Petri dishes and test tubes.

Aluminium Petri Dish Covers

Considerable economy in initial expenditure and reduction in breakages can also be obtained by using aluminium covers. They are cheaper than glass dishes and last indefinitely because they are unbreakable. It is also possible to save space in the incubators and sterilizing ovens because the aluminium are not as thick as the glass covers. For every 19 glass petri dishes, 24 with aluminium covers can be put in the same space. The aluminium covers are approximately a quarter of the weight of glass dishes and this is an advantage in the drop technique, particularly when dealing with large numbers, where the covers have to be lifted to allow the drop to fall vertically from the pipette. Another advantage is that the aluminium covers protect the bacterial growth from light which may be harmful to some organisms.

A disadvantage of the aluminium covers is that colonies growing on the plate cannot be seen from above, but this is not important for colony counts and most routine purposes. For more critical work all-glass Petri dishes are more suitable. It is advisable to adjust the volume of the medium to the different areas of the two sizes of dish which come into use when aluminium covers are employed. The chief disadvantage in using the aluminium covers is that, although their size is uniform, some of the glass dishes tend to curve out slightly at the top, and the aluminium covers may then become jammed and are difficult to remove. Some of the metal covers have rather sharp edges and if handled carelessly it is possible to cut the fingers on them.

Summary

For routine purposes where a large number of tests is involved the drop technique has many advantages over other methods of estimating total colony counts. It is economic with regard to time, labour, equipment, media and space. If aluminium Petri dish covers are also used the economy effected in equipment and space is even greater. No difficulties have been experienced in obtaining complete sterility of the pipettes in the

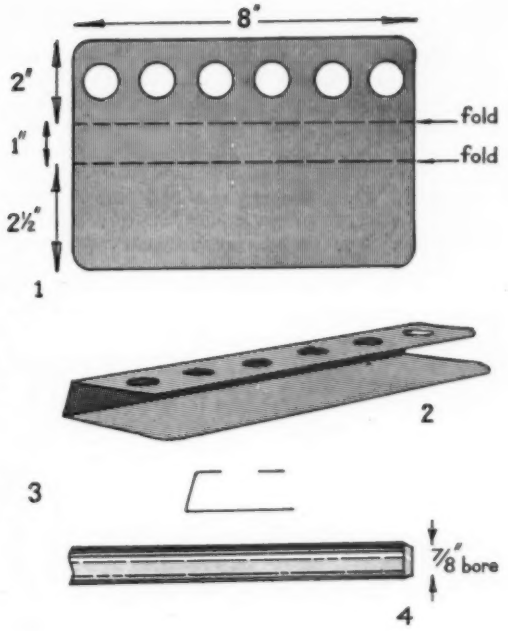
(*Concluded on page 62*)

A Simple Bijou Rack

by L. F. Gore, F.I.M.L.T.

Pathology Department, School of Dental Surgery, University of Liverpool

IN bacteriological work loose ¼ oz. bijou bottles can easily become a nuisance. To keep them in order, especially for rows of 'sugars', racks have been made from thin aluminium sheeting in the following manner. A short length of iron conduit about ⅞ in. diameter is ground at one end to a fairly sharp cutting edge. This tool is used as a punch to form holes in the sheeting at intervals to suit the length of rack desired. A piece of soft wood is placed under the sheet during this operation. In the 8 in. rack illustrated a sheet 5½ in. × 8 in. is punched with six holes ½ in. from the edge along the 8 in. side. The sheet is then placed in a vice and bent at a right angle 2 in. from this edge, and again at 2½ in. from the opposite edge. Finally, the corners of the rack are rounded with a pair of tin snips.



1. Sheet cut and punched ready for folding. 2. Completed rack. 3. Section. 4. ⅞ in. bore conduit, sharpened for punching.

A Simple Apparatus for the Vacuum Distillation of Waxes

by D. E. Herring

E. R. Howard Ltd.

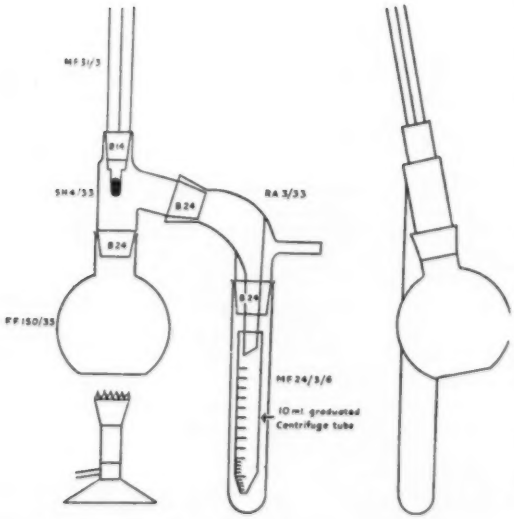


Fig. 1.

Introduction

Hydrocarbon waxes are normally characterized by means of melting point and oil content. These constants, although useful, do not give any indication of molecular distribution in the wax which would be a useful guide both in tracing adulteration and the origin of the sample.

Experimental

Distillation under reduced pressure cannot normally be undertaken in a routine control laboratory because of the complexity of the apparatus. The apparatus illustrated in Fig. 1 has been used in this laboratory; it is simple, gives quick results, and is easy to clean. It consists of a 150 ml. B. 24 flask connected with Quickfit joints so that the distillate can feed into a calibrated centrifuge tube inside a test tube. The receiver test tube and receiver adaptor RA/33 are heated by means of an electrothermal tape and maintained at a temperature of approximately 100°C. All the joints are lubricated with silicone grease. The apparatus is maintained at a pressure of 2 mm. of mercury by means of Speedivac vacuum pump and a Vacustat gauge.

Five g. of the wax is distilled using a Meker-type burner and the flask slightly tilted to prevent splashing

the thermometer. The volume distilled is recorded at 10 degree intervals and the distillation continued to 360°C. when the final volume recovered can be read. The centrifuge tube is then cooled and weighed and the volume readings can be converted to percentages distilled by weight.

Results

Useful results using this apparatus have been obtained with paraffin waxes, microcrystalline waxes, ozokerites, ceresines, F/T waxes and mixtures of these.

AUTHORS' NOTE

TOXICITY OF CONTINUOUS-FLOW HEAT-VOLATILIZED AEROSOLS

In our paper published in your January issue on this subject we referred, just before going to press, to an annotation in the *British Medical Journal* of December 20, 1958, pp. 1522-1523 and indicated in a footnote that we should discuss this in the next issue of your Journal. This annotation entitled 'Does B.H.C. damage the bone marrow?' refers to a few scattered reports that could appear to imply that exposure to lindane can cause agranulocytosis or leukaemia, one case being in a man who had worked in a shop in which a vaporizer had been installed a few months earlier. This case had, however, a preceding infection that had been treated with sulphonamide, chloramphenicol, phenylbutazone and amidopyrine, and as the annotation states: 'It may therefore be unreasonable to blame the vaporizer for the illness. If agranulocytosis were caused by B.H.C., surely it would be much more common among people who handle large quantities of the drug with no particular precautions. At any rate it is among such people that any attempt to substantiate that suspicion should be made'. There has been no time to study the histories of these reported cases but on the face of it there are so many complicating factors that it would be unwise to blame gamma B.H.C. for these blood disorders off hand. Garrod[1] has drawn attention to the dangers of the use of chloramphenicol because of its unquestionable responsibility for aplastic anaemia, a known effect of bone marrow failure. There is indeed 'an unfortunate gap' in our knowledge on the toxicology of many substances and it was our aim to help narrow that gap by undertaking the work described in our paper 'The Toxic Hazard Associated with Continuous-flow Heat Volatilized Insectidical and Acaricidal Aerosols'.

It would greatly add to our knowledge if a thorough study were made amongst those who habitually handle the drug during manufacture and processing.

A. HOWARD BAKER
G. F. H. WHITNEY
ALASTAIR N. WORDEN

[1] Garrod, L.P. 1959. Lancet **1**, 47.

Royal Society Awards

Awards under the Royal Society and Nuffield Foundation Commonwealth Bursaries Scheme are as follows:

Dr. I. R. C. Bick, senior lecturer in organic chemistry, University of Tasmania, to assist him to visit Cambridge, between June 1959 and March 1960, in order to study the latest developments and research techniques in natural products organic chemistry.

Mr. E. H. Davis, senior lecturer in civil engineering, Sydney University, to enable him to study the stress-strain properties of the soil matrix, and the application of the theory of plasticity to soil at Watford and Imperial College, London, from February to December 1959.

Dr. P. R. Davis, lecturer in anatomy, Royal Free Hospital School of Medicine, London, to enable him to extend his studies of African human skeletal material at Khartoum, Ibadan and Makerere, to study fossil Primate material at Nairobi and to visit fossiliferous sites, for six months from February 1959.

Prof. C. M. Donald, professor of agriculture in the Waite Agricultural Research Institute, University of Adelaide, to anable him to study recent advances and techniques in egronomic research at Hurley and elsewhere in the United Kingdom, for three months from April 1959.

Prof. P. C. Dutta, professor of organic chemistry, Indian Association for the Cultivation of Science, Jadavpur, to enable him to gain experience in the field of alicyclic compounds related to terpenoids at Imperial College, London, and Oxford, for about ten months from May 1959.

Dr. A. Iggo, lecturer in physiology, University of Edinburgh, to enable him to gain experience of techniques for the analysis of spinal cord activity and to apply these in further investigation of the nature of rhythmic nervous activity in mammals, at Canberra for about five months from July 1959.

Dr. L. N. D. Lucas, senior lecturer in physics, University of Western Australia, to enable him to gain experience in the use of electron microscopy to study microstructure of solids at several centres in the United Kingdom, for about ten months from March 1959.

Mr. I. L. Mason, of the Agricultural Research Council Unit of Animal Genetics, Edinburgh, to enable him to visit Australia and New Zealand for about ten months in 1959, in order to study animal breeding research there, particularly on beef cattle under tropical and sub-tropical conditions.

Dr. Jean M. Tyler, I.C.I. Research Fellow, department of chemistry, University of Edinburgh, to enable her to carry out structural investigations on West Indian natural products at Kingston, Jamaica, for a year from April 1959.

Dr. J. M. Vincent, associate professor of agricultural microbiology, University of Sydney, to enable him to continue his studies of the root-nodule bacteria at Rothamsted for about eight months during 1959.

The Drop Technique for Colony Counts in Microbiology
(*Concluded from page 60*)

technique described, and reproducibility of drop size was found to be good. Care must be taken, however, when using this technique that the platinum tube is in a vertical position and the drop must be allowed to form very slowly. For very low counts a larger number of drops may be used to overcome the possibility of not obtaining a countable plate.

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BOOK REVIEWS

The Science of Photography, by H. Baines, D.Sc., F.R.I.C., F.I.B.P., HON.F.R.P.S. London: Fountain Press. 1958. 38s. 6d. pp. 319.

The non-scientific photographer who takes his subject seriously is always in search of a book which will give him an intelligent explanation of the fundamentals of photography without being required to take a matriculation course in chemistry and physics.

The title of this book might induce a prospective reader to regard this as yet another volume to be added to the list written on this formidable subject; admirable, authoritative, and equally incomprehensible to the non-scientist. However, the dust cover carries, in addition to the main title, the words 'written for the layman'; the reader will discover this to be no false claim. It is in fact the book for which he has been waiting—a volume of over 300 pages, containing a concise and very lucid exposition of the science of photography, which he will find to be well within his comprehension.

The book should be read methodically from beginning to end since, as the author states, 'one cannot necessarily pick out a chapter at random and find it intelligible, because some of the basic knowledge required may have appeared in earlier chapters'. It is divided into 25 chapters with a foreword by Mr. Percy Harris. We begin with a brief outline of the beginnings of photography and finish with a few tentative prophecies by the author on possible future trends in the photographic world; in between comes the science of photography. Where necessary for a full understanding of the work Dr. Baines has included elementary lessons in science which he suggests may be skipped by those with scientific knowledge; on the other hand these can act as a revision course without undue strain on the reader. In any case they occupy less than a tenth of the whole book so that the scientific reader pays very little for what he does not require in this excellent work.

The nature of light, optical images, the camera lens and camera are dealt with in the earlier chapters, and here the author debunks the cult of the expensive camera indulged in by so many amateurs, explaining how a less expensive camera could cover the type of subject he takes just as adequately. One realizes here that he appears to be on the side of the small camera user. These chapters contain some very interesting and informative sections on perspective, depth of focus, and depth of field. The advantages and disadvantages of diaphragm and focal plane shutters are also dealt with here.

In the chapter headed 'The Chemistry of Photography', the atomic theory, structure of chemical compounds, the use of chemical symbols etc. are explained with great clarity, and help considerably in the understanding of later chapters. It is true that these could not be termed easy reading, but it is certainly fascinating, dealing with the theory of the latent image, and the mechanism and chemistry of development. The author here proves his ability as a master of clear exposition and the reader becomes instilled with the same fascination and interest in the subject, so obviously possessed by the author; this helps considerably in obtaining an intelligent grasp of these very difficult subjects. Fixation and stabilization, sensitometry—both the characteristic curve and its interpretation, and reciprocity failure are admirably dealt with in Chapters 11-14.

Those who have not already discovered the fact from experience should be convinced on reading the chapter dealing with the structure of the granular image 'that due to effective speed loss, fast materials and fine grain development have no advantage over slower fine grain negative material and normal development, in fact the latter is to be recommended'. The additive and subtractive colour processes together with colour printing and masking are covered in the later chapters and again, though not easy subjects, are made comprehensible by Dr. Baines' lucidity of style.

The author also explains, with the aid of a few graphs, the positive process and negative and positive tone reproduction, and shows how we should marry our negative-positive material.

In the final chapters the application of scientific and technical photography is surveyed and, as stated earlier, the work ends with a few tentative prophecies on some future trends in photography.

Your reviewer has found it a pleasureable and fascinating task to read this book, and is left in no doubt that it will become a classic and is thoroughly worth the price of thirty-eight shillings and sixpence.—

NORMAN GRUBER.

Linhof Practice, edited by Nikolaus Karpf, translated by E. F. Linssen, F.Z.S., F.R.E.S., F.R.P.S. Germany: Verlag Grossbild-Technik, Munich and London: Fountain Press. 63s. pp. 216.

This book is a translation from the German edition and, with a few exceptions, well translated. It is a book well worth having. Nothing like it, so up to date and full of information, is at present available. It can be a constant source of reference and—perhaps—inspiration. No book as such can produce the complete photographer, but it can point the way.

I like this book, not only for the information it gives, but for the way it is designed and bound for really hard usage: the case, 9 in. × 11 in., is covered in a stain resistant paper. The text and illustrations are printed on good art paper.

Particularly impressive are the full page photographs in colour and black and white, taken by internationally known photographers. One need not turn any pages to find the diagrams referred to in the text, for they are right next to it, easily understood and to the point. Photographers who, like myself, work in a research laboratory,' know the problems new and old with which we are constatly confronted, and the time we have to spend in planning and experiment. For us 'Linhof Practice' is a friend in need.

Very few laboratories or other scientific institutions

can afford to buy Linhof cameras. Cheaper alternatives are available, such as the the 5 in. × 4 in. MPP Technical, the Miniature Speed Graphic and the De Vere Mono-Rail. They are similar in design to the various types of Linhof cameras described in this book, and 'Linhof Practice' will enable us to use these cameras to their full capabilities.

Starting a photographic section or simply buying new apparatus sets the problem: which type of equipment will do almost everything from taking a portrait of the Director to making a high-power photomicrograph? This manual provides an answer. The first two chapters contain a very sound and convincing argument why the large format camera is essential to obtain maximum quality results. These cameras are precision instruments, and their construction and operation are beautifully illustrated with photographs and diagrams. A very full and well-tabulated description of the optical equipment available for all types of work will help in the choice of the correct lens for a variety of uses.

Apart from the professional photographer, how many workers are familiar with camera movements and their effects? To the uninitiated this is truly an eye-opener. Lack of depth of field is a constant worry in photomacrography, or indeed whenever one photographs small objects. The use of the swing-back on the camera as compared to stopping down of the lens is explained and illustrated. The correction of converging lines as well as perspective distortion is dealt with in this most important chapter.

Chapter 8 describes a Universal stand which can be used in preference to a tripod for various types of photography, particularly in the scientific field. It is used for copying, vertical set-ups in photomicroscopy and photomacrography, and the like. The illustrations for different set-ups, lighting suggestions and techniques in eliminating disturbing reflections will prove helpful to many workers. This chapter also deals with the optical problems in macro-work. Two tables, one giving the highest and lowest magnifications possible with a lens of given focal length, and the other the depth of field at a given magnification, are very seldom found in any text-book, but they are in 'Linhof Practice'.

Unfortunately photomicrography is dealt with very briefly. An illustration shows a typical vertical set-up using the Universal stand. Perhaps as compensation two reproductions of colour photomicrographs give an indication of what can be achieved in this kind of work with a large format camera.

When and how to use filters is still a problem to many. Yet in scientific photography the understanding of filters and their uses is essential. Those who have difficulties and others who wish to reassure themselves find in this book precisely what they are looking for. A colour diagram shows the transmission of the main spectural colours of a blue-green, green-yellow, yellow, orange and light red filter. Below this are transmission curves for seven filters most widely used, plotted transmission against wave length, from ultra-violet to infra-red. As a guide for comparison, sensitivity curves for ortho, panchromatic and blue sensitive emulsion as well as the sensitivity of the human eye are plotted brightness against sensitivity to the visible colours of the spectrum.

Colour photography becomes increasingly important and with it arises the problem of colour temperature. It is dealt with in sufficient detail to settle any colour temperature variations which may crop up when photographing with artificial light in the laboratory, or in daylight. Table I shows when and when not to use Ektachrome daylight film and Type B, and the appropriate colour correction filters to use under given conditions. Table II shows the colour temperature of light sources, the filters to use, and the increase of exposure in fractions of a stop. Table III shows the density of colour correction filters, their absorbtion and exposure increases. All filters described in these tables are Kodak Wratten colour correction filters.

The photographing of metal objects causing specular reflection is a frequent occurrence in almost any laboratory. Use of polarizing filters and the tenting technique are well described and illustrated in the section on lighting. The use of an electronic flash ring illuminator mounted on the lens panel, top lighting using a plate glass as a reflector, and a variety of mirrors, convex and concave, which by reflection increase the number of illuminants, are only a few of the many excellent suggestions.

Under special conditions, stereo work with a single lens camera is well described and different techniques are explained. Ultra-violet photography is very briefly dealt with, and the book gives a number of instances when to use either the direct or fluorescent method. On infra-red photography the book has very little more to say than the basic application, such as the copying of faded documents, and invisible detail in old paintings, and in medicine using infra-red photomicrography in blood investigation. Infra-red filters are described and a useful table for focus adjustment with I-R filters for a variety of Zeiss and Schneider lenses is quite a help.

The Linhof tripods described are, like the Linhof cameras, adaptable to almost any likely position and have a very wide range of accessories. Fortunately these tripods are readily available in this country. Worth mentioning is the elbow joint attachment whereby the camera can be mounted vertically between the tripod legs on to the centre of the column for either copying or photographing small objects. A table shows for which type of tripod various accessories can be used.

This is a book on photographic technique and equipment which no laboratory should be without, for I am sure it will be constantly used for reference.—

M. E. WHEELER.

Methods of Analytical Histology and Histo-Chemistry, by Edward Gurr, F.R.I.C., F.L.S., M.I.Biol., F.R.M.S. London: Leonard Hill (Books) Ltd. 1958. 70s. pp. 327 + xv.

The object of this book is to describe the identification by colour reaction of groups and individual substances in microscope preparations from normal and pathological tissues of all descriptions. The general layout is to

give detailed procedure step by step for each particular substance to be identified, in a manner easy for the technician to follow. Wherever possible the chemical compounds which form as a result of reaction between the colour reagent and the specific substance in the tissues, are described. This is a relatively new approach to microscope technique, and it does of course make more sense of procedures which to so many workers in the past have been merely rule of thumb applications. Such theoretical background must be valuable knowledge from many viewpoints, and for these reasons the author is to be congratulated on his approach. This emphasis on histo-chemistry allows the worker scope for exploration and development of his own particular probl ms using the theoretical knowledge outlined herein.

In general, the book is concerned with relatively simple methods of histology, and there is little or no description of X-ray spectography, ultra-violet light spectography, freezing, drying, etc., which necessarily form a part of modern histological technique. The schemata followed is of interest. The first section of the book is concerned with identification of proteins and amino-acids. The introduction describes the structure and classification of these compounds, then follows the specific staining procedure for the individual substances.

Firstly are given the solutions used, then the technique and finally notes concerning the procedure. Herein are given special considerations, pitfalls, etc., and where possible the chemistry of the reactions. The second section is on carbohydrates, then lipids (including steroids), nucleic acids, pigments, enzymes, and then inorganic substances. The last part of the book deals with sundry technical aspects of histology, and finally an appendix which includes, among other things, a list of dyestuffs used together with their chemical structure.

This type of classification does leave out many of the histological procedures used to identify cells in certain specific pathological conditions, but it is certainly easy to find information required if it is included. The practising histologist is bound to find many omissions in this volume, but the cross references to fuller publications are many, and in view of the increasingly wide scope of the field of histology it is not possible to detail the whole field in one volume. The author and publishers should be congratulated on this work which should have a wide sale outside its immediate sphere.—

R. F. MILTON.

Condensed Phosphates in Foodstuffs. 1958 (in German). Berlin: Springer.

This compact little book is the proceedings of a symposium held at Mainz in 1957. It gives the papers presented there together with the references, and a brief discussion after each paper. The aspects dealt with are chemistry and nomenclature (E. Thilo), occurrence in tissues (K. Lohmann), enzymes (H. Mattenheimer), analysis in foodstuffs (K. Gassner, good bibliography) and W. Nielsch), applications in the meat industry (R. Grau and L. Kotter), applications in the dairy and processed cheese industries (H. Mair-Waldburg), water treatment (P. Hofer), role in animal tissues (K. Lang), pharmacology (H. van Genderen), toxicology (C. H. Schwietzer). These contributions not only review the various aspects of polyphosphates in the food industry but present considerable original data. An English version would be extremely useful to those not able to read German.—J. G. DAVIS.

Safety in the Laboratory, by J. Newton Friend, D.Sc., Ph.D., F.R.I.C. London: Charles Griffin & Co. Ltd.

This handbook, sub-titled 'A Short Manual for Science Teachers' is primarily written for schools. Therefore some very elementary points are made which should be second nature to experienced laboratory workers. Nevertheless, familiarity breeds contempt, and it serves a useful purpose in reminding those who should know better.

The author deviates somewhat from the expressed purpose of the book in chapters about construction, organization and equipping of the laboratory. Naturally in the basic planning the positioning of sinks, arrangements for disposal of waste, etc., will ultimately affect safety in the laboratory, but it is difficult to see how, for example, a formula for a mix to reblacken blackboards comes into this category.

The chapter on store rooms gives useful hints on the positioning of chemicals and apparatus and also recommends stone floors, good lighting and ventilation, etc. If one is given the opportunity of planning the construction of a laboratory from the very beginning all these points can be taken into consideration. Nine times out of ten, however, the laboratory worker must make the best of existing conditions. Of assistance to the science teacher are the recommended list of bench reagents and their strengths, locker equipment, etc., but here again this does not quite fit into the category of safety in the laboratory.

There are many useful hints in the book which come properly within its scope. These deal with handling, pouring and manipulation, replacing and removing stoppers, labelling, use of burners and care of apparatus, etc. There are also chapters on fire fighting and first aid.

It may be helpful to all laboratory workers also in recommending safety apparatus, e.g. polythene buckets for carrying 'Winchesters', which may have escaped their notice.

The book tends to be repetitive. Methods of handling and pouring are outlined on both pages 26 and 47, replacement of stoppers on pages 28 and 49, and the point about adding acid to water is repeated several times. While it is useful to repeat warnings, excessive repetition of these and of architectural details may irritate the reader.

In his prologue the author states that it has been difficult to decide what not to include for fear of making the brochure too large. If he had difficulty in cutting down his material, therefore, it would have been better to keep to the point and lessen repetitions. Or better still, retitle the work, for example, 'Laboratory Organization, with special reference to safety aspects'.—

P. J. STUBBS.

The Encyclopedia of Chemistry (Supplement), edited by G. L. Clark, G. G. Hawley and W. A. Hamor. New York: Reinhold Publishing Corporation. London: Chapman & Hall Ltd. 1958. pp. 330 + vii. 80s.

For those who possess a copy of 'The Encyclopedia of Chemistry' the appearance of a supplement will be most welcome since it fills many of the gaps present in the original volume. A carefully prepared and well-balanced lecture on 'The Present Challenge to Chemistry' by Prof. G. L. Clark serves as an introduction and, generally, his biographical and historical notes are good. As an analyst the reviewer is grateful to Prof. Clark for putting analytical chemistry into its proper place as a branch of chemical science at a time when there is too strong a tendency to think of analysis merely as a tool.

The various monographs have been better prepared than those of the original Encyclopedia though some of the expressions are hardly understandable by the layman, for whose benefit it is partly supposed to have been prepared. The article on physiological digestion, for example, contains a large amount of matter in simple language and is one of the best short accounts the reviewer has seen. On the other hand, the articles on barbiturates, drugs affecting the mental state, narcotics, and sedatives illustrate the difficulty of asking four separate contributors to deal with four such allied subjects.

The conclusion one reaches, therefore, is that this Encyclopedia still remains a book which will lie on the library shelf and be consulted as a last resource rather than as an introduction for further study. If the publishers wish it to have the same popularity as has their 'Condensed Chemical Dictionary' the editorial board will have to do a lot of hard thinking, but the reviewer is convinced that the public needs such a work and hopes that future editions will be planned to this end.—

T. McLACHLAN.

Methods of Testing Chemicals on Insects, edited by H. H. Shepard. Vol. I. U.S.A.: Burgess Publishing Co. 1958. $5. pp. 356 + iv.

The 14 chapters of this volume have been written by different specialists, and broadly speaking the laboratory techniques considered are of two kinds: first, physiological techniques, e.g. for studying the penetration of substances through insect cuticle and the effects of insecticides on respiration; and secondly, techniques used in determinations of toxicity, e.g. methods of exposing insects to fumigants and of dosing them with contact insecticides by topical application, dusting, etc. In his preface the Editor states that this first volume describes general techniques, and a second will describe special techniques such as those for testing repellents and acaricides; if possible a third volume will be published to bring the first two up to date.

Anyone consulting Volume I needs to realize that it is seriously out of date at the time of its publication; of the many references given, one is dated 1955 and all the rest 1954 and earlier. Remarks in the preface imply that closure of the research centre originally sponsoring the book delayed its publication, but (Volume III notwithstanding) it seems unfortunate that Volume I could not have been brought up to date in some way, if only by a classified list of references to later work.

Some of the chapters are individually very good, e.g. those on electrophysiological preparations in the American cockroach and on methods for studying the circulatory system in insects; the chapter on precision spraying is notably comprehensive. Subject to the limitation of omitting recent work, the volume may prove a useful book of reference, but it cannot be recommended as an introduction to the subject as a whole. There is no coherent statement of the principles underlying determinations of toxicity; the different chapters vary greatly in approach and some overlap; certain topics turn up in unexpected places and the meagre index is inadequate for tracing them. For production of an integrated work the contributors needed to be given a clearer idea of its scope and aims, and their contributions required more editing to co-ordinate them.

The printing is clear and the diagrams are excellent.—

P. S. HEWLETT.

The Royal Society

At the Anniversary Meeting of the Royal Society Sir Cyril Hinshelwood, Dr. Lee's professor of chemistry at Oxford University, was re-elected President. The other Officers re-elected for the ensuing year were: Treasurer, Sir William Penney, K.B.E., director of the Atomic Weapons Research Establishment, Aldermaston; Biological Secretary, Sir Lindor Brown, C.B.E., Jodrell professor of physiology at University College London; Physical Secretary, Prof. W. V. D. Hodge, Lowndean professor of astronomy and geometry in the University of Cambridge; and Foreign Secretary, Dr. H. G. Thornton, lately head of the department of soil microbiology at Rothamsted Experimental Station.

Other members of Council elected were:

Dr. G. E. R. Deacon, C.B.E., director of the National Institute of Oceanography, Wormley; Sir Charles Dodds, M.V.O., Courtauld professor of biochemistry in the University of London; Prof. G. Gee, C.B.E., Sir Samuel Hall professor of chemistry in the University of Manchester; Dr. H. Godwin, reader in quaternary research in the University of Cambridge; Prof. L. Hawkes, emeritus professor of geology, Bedford College, in the University of London; Prof. R. D. Haworth, Firth professor of chemistry in the University of Sheffield; Sir Christopher Hinton, K.B.E., chairman of the Central Electricity Generating Board; Prof. A. L. Hodgkin, Royal Society research professor; Prof. N. Kemmer, Tait professor of natural philosophy in the University of Edinburgh; Prof. M. J. Lighthill, Beyer professor of applied mathematics in the University of Manchester; Prof. D. M. Newitt, M.C., Courtauld professor of chemical engineering at the Imperial College of Science and Technology; Prof. G. Pontecorvo, professor of genetics in the University of Glasgow; Prof. R. J. Pumphrey, Derby professor of zoology in the University of Liverpool; Prof. H. W. B. Skinner, Lyon Jones professor of physics in the University of Liverpool; Prof. Wilson Smith, professor of bacteriology at University College Hospital Medical School in the University of London; Prof. J. Z. Young, professor of anatomy at University College in the University of London.

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SHIP HYDRODYNAMICS LABORATORY

THE Ship Hydrodynamics Laboratory now being built at Feltham, scheduled for completion late in 1959 will form part of the Ship Division, of the National Physical Laboratory, D.S.I.R., which already has two towing tanks and a small water tunnel at Teddington.

Requirements for Ship Hydrodynamics Laboratories

Almost every ship that is built presents the designer with some new problems in the matter of hull shape, propulsion arrangement, strength characteristics, cargo-handling requirement and so on. In the hydrodynamic field the naval architect has relied for many years upon the use of scale models to investigate the relative merits of different shapes of hulls and propellers, experiments of this kind dating back 200 years or more. They were first put upon a rational basis by William Froude, who some 90 years ago built a towing tank at Torquay. Since that time practically all maritime countries have built hydrodynamics laboratories of this kind, and following the end of the war in 1945 there has been a vast development in this field.

The first tests carried out on a model of any new ship design are towing tests to measure its resistance and propulsion tests to determine the propulsive efficiency and to ensure that the propeller is correctly matched with the hull. To obtain accurate results the model hull, made in wax, should be 16 to 20 ft. in length, and for tests on such a model a long towing tank is essential to ensure steady conditions over a long enough period of time to obtain satisfactory graphical records of the quantities involved.

Towing tanks of this kind suffer from one or two serious limitations. The pressure of the atmosphere above the water is not reduced to the correct scale pressure, so that the relative pressure at the model propeller is much too high. As a result, the phenomenon of cavitation, in which bubbles or cavities of water vapour and air are formed on the propeller with serious reduction of its performance, does not occur on the model screws until much higher speeds than those at which the ship propeller will cavitate. To simulate correct cavitation phenomena, the propellers are run in a water tunnel where the water is pumped around a closed circuit in which the pressure can be reduced to any desired scale value.

A second limitation of the towing tank is the difficulty of making any visual observations of the flow about a model, since the air-water interface is distorted by the model's own wave system. As a result very little is known of the flow pattern around a model hull, particularly near the stern. In consequence, comparisons between different models as regards resistance and propulsion can only be made on the basis of overall performance, and there are no means of explaining differences scientifically but only on an empirical basis or by statistical or intuitive reasoning. If rational progress is to be made in the understanding of ship resistance and propulsion, it is essential to be able to study the flow conditions about a model hull in detail and under fully

controlled conditions. These studies can be carried out in a circulating water channel filled with flowing water in which a model is placed, the flow being observed through windows in the sides and bottom of the channel by means of dye ejected from the model or tufts of coloured wool on its surface. The water is circulated at any desired speed by means of powerful pumps.

It is also necessary to study the behaviour of ship models in waves in order to ensure that the actual ships shall have good sea-keeping qualities. Although waves can be made in the long towing tanks, such waves can only be made to run head-on or stern-on to the models. To carry out tests in waves at different angles to the model's heading or in confused seas and to investigate manoeuvring qualities it is necessary to have a sea-keeping basin, usually rectangular or square in shape, with wave-makers down two adjacent sides, in which self-propelled, radio-controlled models can be run at any desired angle to the wave crest.

The New Laboratory

To summarize, the facilities desirable in a well-equipped hydrodynamics laboratory are towing tanks, cavitation tunnels, circulating water channels and sea-keeping basins. On the completion of the present phase of the Feltham project, the Ship Division of the National Physical Laboratory will be adequately provided with such facilities, together with workshops for making model hulls, propellers and instrumentation. A circulating water channel is not included, and as there is no such facility anywhere in the United Kingdom the question of whether to build one is under consideration.

The existing facilities at Teddington consist of two towing tanks 500 and 680 ft. long and one water tunnel having a measuring section 18 in. × 18 in. They are used essentially for the testing of merchant ship models and for research in hydrodynamics in this general field. The Admiralty has its own testing facilities, while there are in addition four tanks owned by private shipbuilding firms. The facilities at N.P.L. have never been adequate to cope with the demand for tests from the industry and it has been difficult in consequence to maintain an adequate research programme upon which the ships of tomorrow depend.

In 1946 plans were made to add new equipment and facilities, but for a number of reasons, chief among which was the difficulty of finding a suitable site, the work of construction did not get under way until 1955. It was impossible to build new tanks on the present side at Teddington, and after much difficulty a new site was found at Feltham, just under five miles from N.P.L.

The Towing Tank

The new towing tank is 1,300 ft. long, 48 ft. broad and 25 ft. deep. The original design called for a length of 1,700 ft., but in order to keep the overall cost within the £2M allowed, the length was cut, although space is available for a future extension. There will be a wavemaker at one end so that experiments can be made with models head-on or stern-on to the seas. The wavemaker will be able to generate waves up to 40 ft. in length and 2 ft. high. The long length of the tank is partially due to the need to be able to run the model through regular and irregular seas for long enough time to obtain complete cycles of motion, and partially to ensure a long enough steady run for making measurements at high speed. The tank will be spanned by a towing carriage driven by electric motors and capable of a top speed of 50 ft. per second, i.e. 30 knots. In measuring ship model resistance, it is essential that the carriage speed remains as steady as possible and to ensure this electronic control will be fitted to the driving motors and special care paid to the finish and levelling of the rails. The latter indeed are not straight, but are parallel to the water surface in the tank, and so partake of the earth's curvature. At the centre, the rails will be separated 0·12 in. from the straight line connecting the ends.

The Water Tunnel

The new water tunnel will have a measuring section 44 in. diameter, and a large pump will circulate water through this section at any desired speed up to 30 knots. It will be possible to test model propellers up to 24 in. in diameter in the tunnel, and special dynamometers are being built for carrying out tests on hydrofoils also. The behaviour of these latter under cavitating conditions are of extreme interest both for propeller design and for hydrofoil boat problems. When carrying out cavitation tests in such a tunnel, there are regions of low pressure behind the propeller or foil in which cavities containing water vapour on air may form. As it is necessary to arrange that the water re-absorbs these air bubbles so that its air content remains constant and its clarity unimpaired, the new tunnel will incorporate a 'resorber', the lower limb of the tunnel circuit will be of large diameter and 180 ft. below the measuring section, so that the water after passing the model propeller will pass slowly around the resorber, under great pressure, and the air bubbles will have time to be re-absorbed into solution before the water again reaches the measuring section. At the present time only the resorber is complete, and the measuring sections above ground level are not yet erected, so that there is little of the tunnel to see.

Sea-keeping and Manoeuvring Basin

The sea-keeping and manoeuvring basin is 100 ft. square. At first it will have wavemakers along one side and beaches for absorbing the waves on the opposite side. These wavemakers will be able to generate regular or irregular waves, and the models used will be about 10 ft. long, with their own propulsion motors and rudders radio-controlled from shore. The model will be fitted with recording equipment to measure pitch, heave, yaw and roll, the information either being recorded in the model or telemetered ashore. The model will be automatically tracked from three shore stations, and it is hoped to record this information directly on tape so that the path can be computed by machine without further manual analysis. After experience has been gained in the techniques of generating and measuring irregular and confused seas, it is intended to design wavemakers for one of the other sides of the basin for use in conjunction with the original wavemakers.

In addition to the main facilities, there are wax, wood and metal shops for making models of hulls and propellers, a vibration laboratory and instrument laboratories for testing and calibration.

Distribution of Work

When the new Laboratory is in full commission, the Ship Division, N.P.L. will have the following facilities:

No. 1 Tank, the 500 ft. towing tank at Teddington.
No. 2 Tank, the 680 ft. towing tank at Teddington.
No. 3 Tank, the 1,300 ft. towing tank at Feltham.
No. 4 Tank, the manoeuvring and sea-keeping basin at Feltham.

(*Concluded on page 69*)

The Future of Industrial Microbiological Research

The Council for Scientific and Industrial Research have been considering certain aspects of the organization and support of industrial microbiological research, which within their own establishments is undertaken at the Water Pollution Research Laboratory, the National Chemical Laboratory, the Low Temperature Research Station, the Ditton Laboratory and the Torry Research Station.

The Council believe that an industrial microbiology team is able to do the best and most effective work when it operates within a research laboratory concerned with the technology served by the team. In this way the team is given a firm practical objective and a powerful *raison d'être*. This is the position in the Water Pollution Research Laboratory and the food research laboratories.

Although the microbiology group at the National Chemical Laboratory, numbering less than 20, has done good work, the Council consider that it is inappropriately placed there, and, apart from those working on the corrosion of metals, the chemical groups do not benefit from the microbiological work.

The Council have concluded that microbiological research work of the kind being undertaken at the National Chemical Laboratory, apart from that concerned with the corrosion of metals, would in general be most effectively carried out in university departments and they propose to encourage the expansion of such work by making grants to universities for promising investigations.

The work on microbiology at the National Chemical Laboratory is in four main parts, viz.:

(i) The National Collection of Industrial Bacteria.
(ii) Study of metal corrosion.
(iii) Investigation of sulphur bacteria.
(iv) Investigation of methane-producing bacteria.

The Council have decided that the microbiology group at the National Chemical Laboratory should be gradually dispersed and that the future of the work should be as follows:

(i) The Department of Scientific and Industrial Research will continue to maintain the National Collection of Industrial Bacteria, and consider that this will be best done at the Torry Research Station where there is already a comparable collection of marine bacteria.
(ii) The microbiological research concerned with metal corrosion will be retained at the National Chemical Laboratory and strengthened.
(iii) The fundamental investigation of sulphur bacteria will be brought to a conclusion at the National Chemical Laboratory, though allied work may be supported at a university, if this is considered to be justified.
(iv) Fundamental work on microbial formation of methane can very appropriately be carried out in a university.

Applied research in the fields covered by (iii) and (iv) is within the field of activity of the Water Pollution Research Laboratory, where any further work will be carried out if this is considered to be necessary. The Department will continue if desired to advise the London County Council on the pilot-scale trials which they are making for the treatment of sewage involving the production of hydrogen sulphide by sulphate-reducing bacteria.

The views of the Microbiology Committee of the Chemistry Research Board were made fully known, to the Chemistry Research Board, the Secretary of the Department of Scientific and Industrial Research, and the Review Committee of the Research Council and through them to the Steering Committee of the National Chemical Laboratory and to the Council.

The Council re-affirm their intention to build up a strong microbiology group at the Water Pollution Research Laboratory in order that a study of the processes which occur in the treatment of sewage, industrial effluents, and the purification of rivers may lead to a better understanding and control of practical methods of treatment and to the development of new or improved methods.

The staff of the Microbiology Group, will be transferred with the National Collection, to the Water Pollution Research Laboratory or remain at the National Chemical Laboratory as may be appropriate.

Panel Instrument Fund Committee

Awards of grants by the Paul Instrument Fund Committee have been made as follows:

£3,835 to Prof. A. L. Cullen, professor of electrical engineering in the University of Sheffield, for the construction of a detector in which radiation pressure is used to convert a microwave signal to an audio of intermediate frequency.

£545 to Dr. R. Feinberg, of the electrical engineering department, Manchester College of Science and Technology, for the construction of an instrument for measuring the intensity of soft X-radiation generated in experimental high voltage valves.

£1,000 to Mr. R. M. Sillitto, lecturer in natural philosophy, University of Edinburgh, for the development of a 30-channel pulse-height analyser, using transistors in place of thermionic valves.

The Paul Instrument Fund Committee, composed of representatives of the Royal Society, the Physical Society, the Institute of Physics and the Institution of Electrical Engineers, was set up in 1945 'to receive applications from British subjects who are research workers in Great Britain for grants for the design, construction and maintenance of novel, unusual or much improved types of physical instruments and apparatus for investigation in pure or applied physical science'.

Ship Hydrodynamics Laboratory

(*Concluded from page 68*)

No. 1 Water Tunnel, the 18 in. × 18 in. tunnel at Teddington.

No. 2 Water Tunnel, the 44 in. diameter tunnel at Feltham.

In general tests of commercial ship models in smooth water will be carried out as at present in No. 1 tank, and tests of propellers in open water for the same models in No. 2 tank. Tests of commercial models in rough water will be carried out in Nos. 3 and 4 tanks. Commercial tests of propellers in the cavitating condition will in general be carried out in No. 1 tunnel.

It is expected that a great deal of the research work will be carried out in Nos. 3 and 4 tanks, since it is believed that increasing emphasis will fall on seagoing qualities of ships and the new facilities at Feltham will be extremely valuable in this field. Various other researches such as that on skin friction and roughness, ship-model correlation, wavemaking resistance and boundary layer investigations will also be carried out in the new tanks where larger models can be used than is possible in the existing Nos. 1 and 2 tanks.

No. 2 tunnel, with its large diameter of 44 in., will be used mostly for research into cavitation on marine propellers and hydrofoils. This work is likely to grow in importance with the increasing demand for high speeds in ships of all classes.

Research aimed to reduce vibration in ships, which is mostly concerned with that excited by the propellers, will also be carried out at Feltham in the specially equipped vibration laboratory.

Laboratory Note-Book

THE Directors of the Applied Physics Division, National Research Council, Ottawa, Canada, the Dominion Physical Laboratory, Lower Hutt, New Zealand, the National Bureau of Standards, Washington, United States, the National Physical Laboratory, Teddington, United Kingdom, the National Physical Research Laboratory, Pretoria, South Africa, and the National Standards Laboratory, Sydney, Australia, have discussed the existing differences between the values assigned to the yard and to the pound in different countries. To secure identical values for each of these units in precise measurements for science and technology, it has been agreed to adopt an international yard and an international pound having the following definitions:

the international yard = 0·9144 metre;
the international pound = 0·453 592 37 kilogramme.

It has also been agreed that, unless otherwise required, all non-metric calibrations carried out by the above laboratories for science and technology on and after July 1, 1959, will be made in terms of the international units as defined above or their multiples or submultiples.

The new international units conform with the recommendations of the Board of Trade Departmental Committee on Weights and Measures Legislation (the 'Hodgson Committee') but the Board of Trade point out that the units will have no statutory force in the United Kingdom and may not be used for trade purposes in this country. The yard and pound units to be used in trade are the imperial units laid down in the Weights and Measures Act, 1878.

The values of the yard currently in use in the British Commonwealth and the United States of America are as follows when expressed in terms of the metre:

1 imperial standard yard = 0·914 397 2 metre

1 Canadian yard = 0·9144 metre

1 yard as at present used by the National Physical Laboratory for science and technology, based on the 1922 value of the imperial standard yard = 0·914 398 41 metre

1 United States yard = 0·914 401 83 metre

As the imperial standard yard is about five parts per million (0·0002 in.) less than the United States yard (which is defined in terms of the metre) and is shortening at the rate of over one millionth of an inch per annum, the consequent discrepancies in measurements of length are important in modern precision engineering. To give two examples, it is necessary to know the lengths of the highest grade block gauges accurately to one part per million, and the permissible error on accurate yard scales is 0·0001 inch. Although the N.P.L., by using the metre and wavelengths of light and by adopting the 1922 value of the imperial standard yard in relation to the metre, has been able to stabilize its basis of reference for length measurements in terms of the yard and its common submultiples for science and technology, unification of the yard standard for these purposes in the British Commonwealth and the United States can no longer be delayed.

With regard to the pound, the values currently in use when expressed in terms of the kilogramme are:

1 imperial standard pound = 0·453 592 338 kilogramme

1 Canadian pound = 0·453 592 43 kilogramme

1 United States pound = 0·453 592 4277 kilogramme

There is evidence that the imperial standard pound has diminished by about seven parts in 10 millions since 1846. It is about two parts in 10 millions (0·0014 grain) smaller than the United States and Canadian pounds, which are defined in terms of the very closely safeguarded international prototype kilogramme. Although the discrepancy between the pounds is not at present causing any technical difficulty the coexistence of independently defined pounds is unsatisfactory in science and technology.

The agreed international values of the yard and the pound fall between the existing United States and British units, and the international yard, which is the same as the Canadian yard, accords exactly with the relationship 1 inch = 25·4 millimetres, which is already extensively used in this country and abroad for approximate conversions. The adoption of the international values of the yard and the pound will be of particular benefit to all those concerned with accurate measurements of length and mass for scientific and technological purposes in the British Commonwealth and the United States.

Common Cold still a Mystery

Once again the Common Cold Research Unit is appealing for volunteers to act as human 'guinea pigs', in the search for a solution to this great medical mystery. Men and women, between 18 and 45 and in normal health, are urgently needed so that the research team can continue their investigation without interruption during 1959.

Of all individual diseases the common cold affects the largest number of people in this country; a recent study showed that over 81 of every 1,000 patients consulting the general practitioner were suffering from its effects. The loss to the national effort from its prevalence is certainly enormous.

So volunteers for 10 days with the Common Cold Research Unit, which is run jointly by the Medical Research Council and the Ministry of Health, can feel that they are playing a small but important part in an investigation of immense potential value to mankind.

Dr. Christopher Andrewes of the Medical Research Council, who is in charge of the Unit, stated that during 1958 the work at the Common Cold Research Unit had a definitely international aspect. Workers in several countries (U.S.A., Sweden, Denmark, as well as Britain) have grown in cultures of living tissues a number of viruses from minor infections resembling colds, particularly in children: the question has arisen whether viruses can be held responsible for causing a larger part of the commonest kind of common cold. These newly discovered viruses have been under study at the Salisbury unit, both in the laboratory and by inoculating them into volunteers. While they have caused some mild symptoms there has emerged no evidence that any of them cause common colds—at best hey may cause some more or lesst 'uncommon colds'. An interesting point is that several of them appear to lose their ability to cause symptoms in man after they have been grown for a short while in tissue cultures. The results of studying these 'uncommon colds' may prove helpful in tracking down the virus or viruses causing the common cold.

Progress would be rapid if the virus could be regularly cultivated within the laboratory, but until this comes to pass we cannot do without the services of human volunteers.

At the Harvard Hospital, Salisbury, where the Common Cold Research Unit has been established since 1946, comfortable living quarters are provided for the volunteers. Fares to and from Salisbury are paid up to a maximum of £3 and 3s. a day pocket money is allowed to each volunteer. The volunteers are usually isolated in pairs and may come with and be partnered by a friend. Those who come alone will be provided with a partner if they so wish. A postcard to the Medical Superintendent, Harvard Hospital, Salisbury, will bring full details.

D.S.I.R.'s New Five-year Plan

Expenditure on research by the Department of Scientific and Industrial Research will be nearly doubled in the next five years. Under its second five-year plan, for the period 1959-64, approximately £61 million will be made available to the Department, compared with £36 million for the first quinquennium which ends on March 31, 1959.

Expansion will continue steadily throughout the period and for the year 1963-64 expenditure is planned to reach about £14 million. This figure does not include certain items, the largest of which is the British contribution to the

(*Continued on page* 72)

News from the British Association of Chemists

Unemployment Among Chemists

During the past year we have noticed an increase in the number of cases of termination of appointment among our members. The chief causes appear to have been amalgamations and the pruning of expenses, due to tighter condition of trade. The chief sufferers are the 'over 40's' and it is these, of course, who experience the greater difficulty in obtaining new posts. They are also usually the hardest hit, in that they nearly all have family commitments—often at the most expensive stage. A period of six months or more of unemployment, which is by no means uncommon, makes serious inroads in their resources.

Curiously enough the amount of benefit paid out by our Unemployment Benefit Fund last year is rather less than the amount disbursed during the previous year. This is because some of the members concerned had elected not to become contributors to the U.B.F. or had only joined the B.A.C. when they knew that their appointments were about to be terminated. Too often have we seen the sad spectacle of a man mentally kicking himself for not having bothered to join the B.A.C. or, if already a member, to become a contributor to its Unemployment Benefit Fund a year earlier.

We find it difficult to understand why more chemists do not bother to take advantage of this form of insurance when they can, for instance, *at a cost of just over* 2*s. per week*, provide for the payment to them of £5. 8s. per week for up to 26 weeks (and at a reduced rate for a further period) if they become unemployed.

It is interesting to note that the recent recession in the U.S.A., which caused the dismissal of a number of chemists and chemical engineers, had its effect on our unemployment Benefit Fund. One of our members who had taken a post in the U.S.A. some years ago, was one of those who lost his employment. He had, however, some cause to congratulate himself that he had maintained, not only his membership, but his U.B.F. contribution. Although domiciled abroad, he was still entitled to benefit and in actual fact we were able to secure currency control permission to apply the amount due to him in settlement of certain commitments which he had in this country.

The Reserves of the U.B.F. are equivalent to the amount which would be required to pay benefit for six months to every contributor, if they were all unemployed simultaneously.

B.A.C. Salary Scales

New scales have been prepared by our Salary Scales Committee for 1959. These show some increases to provide for the increase in the cost of living and there have been some alterations in the grading of 'Chemical Assistant' and 'Laboratory Assistant' sections.

Advantages of Membership of the B.A.C.

Minimum Salary Scales.
Free Legal Advice on Professional Matters.
Appointments Service.
Unemployment Benefit.
Negotiations with Employers.
Group Scheme for Private Medical Treatment.
Certain advantages in connection with Insurance.
Trading Scheme.
Benevolent Fund.
Lectures, Discussions and Social Functions.

Services to Members

A member who suffered an injury in the course of his work obtained, through the B.A.C. Legal Aid Department, a compensation payment of £80. The original offer by the employer's insurance company was £50.

Fédération Internationale des Cadres de la Chimie et Industries Annexes

This organization, which was founded in 1956, one of the founder members being the B.A.C., and which was subsequently admitted to membership of the Confédération International des Cadres, has now got well into its stride in its work for the benefit of chemists.

Special Committees were formed to deal with a number of problems which preliminary studies had shown to be common to chemists in a number of countries. Two of these committees have completed their work and, as a result, proposals are to be put forward through the C.I.C. for consideration at an international conference under the I.L.O. at Geneva in 1959. These are in connection with 'Restrictive Agreements' and 'The Protection of Salaried Chemical Inventors'.

The studies of both F.I.C.C.I.A. and the C.I.C. have shown that the problems of employed professional men are identical throughout the free world and the B.A.C. is proud to be once again in the vanguard, as regards Great Britain, in initiating steps to obtain proper representation for them at the highest international level.

In this connection the point has now been reached at which the C.I.C. has been invited by the I.L.O. to maintain permanent representation at Geneva, as do the other organizations (employers associations, manual workers unions, governments, etc.) which negotiate there. In effect, therefore, 'employed professional men' are now recognized as a body for negotiating purposes at the I.L.O. whereas formerly their existence was not recognized officially.

It must be pointed out that this work cannot be done without cost and the present members of the B.A.C. are bearing the whole burden as regards Great Britain. We hope, therefore, that chemists who are not yet members will, by joining it, give the B.A.C. the necessary support in this valuable work in their interest as well as in its efforts on their behalf at home.

From the correspondence columns of the B.A.C. Journal

'Noses to the Grindstone'

'It is surprising that one still hears of managements who are unable to realize that chemists are members of a profession, and as such are reasonably entitled to spend a small amount of their working time studying developments in that profession. Far too often chemists are expected to spend their entire time on immediate problems which must, in the long run, reduce their efficiency. Rather strangely, I find that "chemists gone wrong", i.e. those who have elected to have a career in commerce or administration, are amongst the worst offenders, and often play a part in prejudicing their non-technical colleagues at management level.'

News from the Sections

Liverpool

A programme entitled 'Salaries and Conditions in Industry for Chemists' has been arranged. This will be held at Radiant House, Bold Street, Liverpool on Thursday, February 26, 1959, at 7 p.m. Visitors will be welcome and further particulars may be obtained from:

Mr. C. J. H. Wylie,
83 Rullerton Road,
Wallasey,
Cheshire.

London

A lecture entitled 'The Disposal of Effluents of Chemical Works' will be given by J. L. Hewson, Esq., B.Sc., A.R.I.C. (of I.C.I. Chemical Engineering Services Dept.) at The Wellcome Institute, 183 Euston Road, London, N.W.1, on Wednesday, February 11, 1959, at 7 p.m. Visitors will be welcome.

All correspondence and enquiries concerning this Association should be addressed to G. R. Langdale, Esq., The British Association of Chemists, Nomination Dept., 14 Harley Street, London, W.1. Tel.: Museum 7021.

CATALOGUES, BROCHURES & LEAFLETS

Received from Manufacturers

New Instruments.—W. G. Pye & Co. Ltd. of Granta Works, Newmarket Road, Cambridge, have recently issued three new leaflets. These deal with the conductivity meter 'W', designed for the measurement of electrolytic conductivity in the range which is appropriate for distilled and deionized water, the Dynacap pH meter, and a two-dimensional measuring microscope.

Heat-Treatment Journal.—Articles on the care of platinum thermocouples, control gear as applied to electric furnaces, and a vacuum fusion gas analyser are included in the December 1958 (Vol. VI, No. 49) issue of the Wild Barfield Heat-Treatment Journal, published by Wild-Barfield Electric Furnaces Ltd. of Elecfurn Works, Otterspool Way, Watford By-Pass, Watford, Herts.

Laboratory Electric Furnaces.—A new brochure describing their laboratory electric furnaces has been published by The Pyrometric Equipment Co., Ltd., of Unity Works, 49 High Street, Market Harborough.

M & B Laboratory Bulletin.—The latest edition of the M & B Laboratory Bulletin (Vol. III, No. 3) published by May & Baker Ltd., Dagenham, Essex, contains Part XV of the series of articles on The Chemist in Industry, Some Laboratory Aspects of Crime Detection, and The Machine Translation of Languages.

Platinum Laboratory Apparatus.—Johnson, Matthey & Co., Limited of 73-83 Hatton Garden, London, E.C.1, have produced a new publication, 1700—Platinum Laboratory Apparatus, that revises and combines the earlier booklets 1710 and 1720. This publication makes a comprehensive survey of the platinum laboratory apparatus and electrodes in the JMC range and includes useful advice on care and maintenance.

Electronic Potentiometers.—Publication No. 197, now available from Electroflo Meters Co., Ltd., Abbey Road, Park Royal, London, N.W.10 (member of Elliott-Automation Group) describes the new electronic potentiometer—a high-speed, continuous balance null type instrument designed to register low potential electrical values from signal sources such as thermocouples, resistance thermometers, flow meters, strain gauges, shaft position indicators, etc.

Laboratory News.—No. 1 (Third Series) of Laboratory News has now been published by J. W. Towers & Co., Ltd., of Victoria House, Widnes. It contains details of many developments both of the company's own productions and those of others in the industry.

Square Wave Polarograph Mk. III.—A leaflet describing the Mervyn-Harwell square wave polarograph Mk. III, has been issued by Mervyn Instruments, St. Johns, Woking, Surrey.

Marconi Instrumentation.—The December 1958 issue of *Marconi Instrumentation*, published by Marconi Instruments Ltd., St. Albans, Herts., contains the annual review and articles describing the Marconi television measuring oscilloscope, carrier deviation meter and a new Marconi A.M. signal generator.

Semiconducting Materials and Transistors.—A comprehensive booklet under the title of 'Fifteen Years of Semiconducting Materials and Transistors' has been published by the Newmarket Transistor Co. Ltd. of Exning Road, Newmarket. This is in the nature of a bibliography and comprises 2,511 references.

Ion-Exchange Celluloses.—Suitable for the performance of chromatographic fractionations of high-molecular-weight materials beyond the range of conventional resins, a new series of four analytical-grade ion-exchange materials based on cellulose is being offered by Bio-Rad Laboratories, 32nd and Griffin Avenue, Richmond, Calif. An extremely porous and hydrophilic character permits their use with such substances as serum proteins, nucleic acids, and enzym s.

Identified by the name Cellex, the new materials are based on work originally done at the National Institutes of Health by Elbert A. Peterson and Herbert Sober. (J.Am.Chem.Soc., 1956, **78**, 751).

They have the following characteristics: Cellex-E is a monofunctional anion exchanger with only tertiary amine functional groups; Cellex-D is a monofunction anion exchanger with only tertiary amino functional groups; Cellex-P is a dibasic cation exchanger with phosphoric acid functional groups; and Cellex-CM is a cation exchanger with only carboxymethyl sites as functional groups.

Details on functions, applications, and prices are included in a leaflet which also contains references to published works in this area of the ion-exchange field.

Aluminium Oxides for Chromatography.—The second enlarged edition of the Woelm booklet entitled 'Chromatography on Aluminium Oxides' has been sent to us by L. Light & Co., Ltd., of Poyle Estate, Colnbrook, Bucks. The three grades of aluminium oxides supplied by Woelm are freely available in the U.K.

Organic Chemical Reagents.—Monograph No. 36, published by Hopkin & Williams Ltd., Chadwell Heath, Essex, deals with *p*-bromomandelic acid, reagent for zirconium, and has been prepared by E. J. Newman, B.Sc., A.R.I.C.

B.D.H. Leaflets.—New entries in the catalogue of British Drug Houses Ltd., Poole, Dorset, are listed in the September/October 1958 issue of their monthly leaflet. These are as follows:

Organic and Inorganic Chemicals.—Bornyl chloride; 1:3-dioxolane; isethionic acid sodium salt; papain, crystalline; potassium diuranate; sodium diuranate; 'union carbide' molecular sieve type 13X.

Sugar Phosphates.—The properties, preparation and uses of the more important sugar phosphates are described in a 20-page booklet issued by British Drug Houses Ltd., Poole, Dorset. Copies may be obtained on application to the company.

Laboratory Note-book

(*Concluded from page* 70)

European Organization for Nuclear Research (C.E.R.N.) which will continue to be financed outside the five-year plan.

The largest expansion is planned to take place in the field of scientific grants to the Universities. Post-graduate awards to students will be increased by about 10 per cent each year until in 1963-64, it is hoped that some 3,800 students will be receiving D.S.I.R. grants for research training. In the same year it is expected that D.S.I.R. support for special research in the research departments of universities will be operating on a scale of about £1¾ million per annum.

In support of additional research carried out in the Department's own laboratories, expansion of staff at the rate of about 6 per cent per annum—or approximately 30 per cent over the five years—is included in the plan.

Grants to the Research Associations will also be increased to over £2 million per annum by the end of the period. At present there are 49 organizations in the D.S.I.R. scheme. The Council for Scientific and Industrial Research will continue its policy of encouraging industry to bear an increasing proportion of the total cost. It may be expected, therefore, that the actual expansion of the R.A. movement will be proportionately greater than the increase in Government grant.

It has also been decided to devote much more attention and more money to ensure that the results of scientific research are known and applied.

It is also proposed that the Ministry of Works will increase its rate of expenditure on behalf of D.S.I.R. so as to provide buildings and equipment for the increased staff of D.S.I.R. laboratories. The works programme includes the provision of a new laboratory at Crowthorne, Berkshire, to rehouse the Road Research Laboratory which at the moment occupies two separate sites a few miles apart, one at Harmondsworth, Middlesex, and the other at Langley, Bucks. The new Road Research Laboratory will include an experimental road system.

LABORATORY EQUIPMENT & APPLIANCES

Cone and Plate Viscometer

The Ferranti-Shirley viscometer is a cone and plate rotational viscometer of advanced design which enables the flow behaviour of many types of simple or complex fluids to be examined. It is capable of giving precise measurements of apparent viscosity over a wide range of rates of shear or shearing stress. Moreover, by reason of its simplicity, versatility and speed of operation, it may be used to great advantage where large numbers of routine viscosity measurements are required for process control. In the hands of chemists, physicists and rheologists it should prove an extremely valuable research tool.

The viscometer has been developed from principles devised by, and an original instrument used by, the British Cotton Industry Research Association. During the course of development the research organizations of other important industries were consulted in order to ensure that the instrument should cover as wide a field of use as possible.

In simple (or Newtonian) fluids, viscosity is defined in absolute units as the ratio of the force (or shearing stress) required to maintain a unit velocity gradient (or rate of shear) in the fluid. At constant temperature the viscosity is independent of rate of shear, therefore a single measurement made in a capillary or efflux viscometer serves to describe the flow behaviour of these fluids, examples of which are vegetable oils, sugar solutions and organic solvents.

The Ferranti-Shirley cone and plate viscometer complete.

The majority of fluids, however, are not of this simple type and their flow properties are more complex. These are the non-Newtonian fluids and in many instances the only satisfactory way of characterizing them is by means of flow curves in which apparent viscosity is plotted against rate of shear or shearing stress.

The mathematical analysis of viscosity data for complex systems, particularly those exhibiting thixotropy, is greatly simplified if the material under test is subjected to a uniform rate of shear. This cannot be accomplished with a capillary viscometer and can only be approached with the co-axial cylinder type for very small gapwidths and large diameter cylinders. To attempt to secure high rates of shear with a fairly wide gap by using high speeds of rotation is to court serious errors arising from the generation of heat within the fluid. A co-axial cylinder viscometer with a narrow gap is not only difficult to construct but difficult to fill, clean and manipulate. These disadvantages are largely overcome in the Ferranti-Shirley cone and plate instrument. The fluid to be examined (less than 0·5 ml. in volume) is sheared between a stationary flat plate and a slightly conical rotating disc driven at controlled speeds ranging from 1 to 1,000 r.p.m. The cone speed is directly proportional to the rate of shear. The viscous drag on the cone is shown on the indicator unit and is directly proportional to the shearing stress. Thus the apparent viscosity at any rate of shear or shearing stress is readily determined, and flow curves for complex fluids can be constructed with great facility.

The Ferranti-Shirley viscometer consists of a stationary flat plate and a slightly conical rotating disc driven by a variable speed motor. Infinitely variable rate of shear over a very wide range is provided by electronic control of the motor speed. When the sample fluid is sheared in the narrow symmetrical gap between the cone and the plate, the viscous traction on the cone exerts a torque on a precision electro-mechanical torque dynamometer. This is communicated to an electrical measuring instrument giving clear readings on a finely divided scale having an actual length of 5 in. and an effective length of 25 in.

Thermo-couples embedded in the plate (in direct contact with the fluid) enable temperature measurements to be obtained. The plate is also provided with a water jacket through which water at a constant temperature may be circulated. (Manufacturers: Ferranti Ltd., Hollinwood, Lancs.)

A New Oven

An entirely new oven is now being introduced. A high grade refractory brick lining is used on the interior of the oven, on all sides, that is, except the internal surface of the vertically sliding door which is faced with Marinite. Behind the brickwork is a secondary thermal insulation consisting of 3 in. thick slabs of Caposil. This highly efficient thermal insulation allows a maximum temperature of 1,000°C to be achieved on a loading of only 12 kilowatts. The loading—and the maximum temperature—can be increased to meet specific customer requirements.

The whole unit stands on a 20 in. high robust sheet steel base of folded and welded construction. The central portion includes a folded back control panel which gives immediate and uninterrupted viewing of the controls from a normal standing position. On the sides of the equipment are situated two readily accessible terminal covers through which it is possible to withdraw all the heating spirals in a matter of minutes. The spirals themselves are high quality resistance wires which fit into grooves in the base of the refractory brick lining.

Inside the base are counter balance weights which enables the door to be raised easily and quickly.

The sheet metal which forms the base actually extends to cover the whole of the oven apart from the door. It provides an air space around the oven proper

The new Stabilag oven.

which provides an added measure of insulation while at the same time keeping the outer surface free from heat. Air-space insulation is also used in the observation window of the door which consists of two layers of quartz.

The oven's internal dimensions are height 18 in., depth 12 in., width 36 in., volume 4½ cu. ft. Loading is 12 kilowatts maximum temperature 1,000°C.

Applications include the annealing of glass and case hardening, but a general description would be the obtaining of high temperature conditions under close control to meet the requirements of medium-sized production plants or laboratories.

(Manufacturers: The Stabilag Co. Ltd., Mark Road, Hemel Hempstead, Herts.)

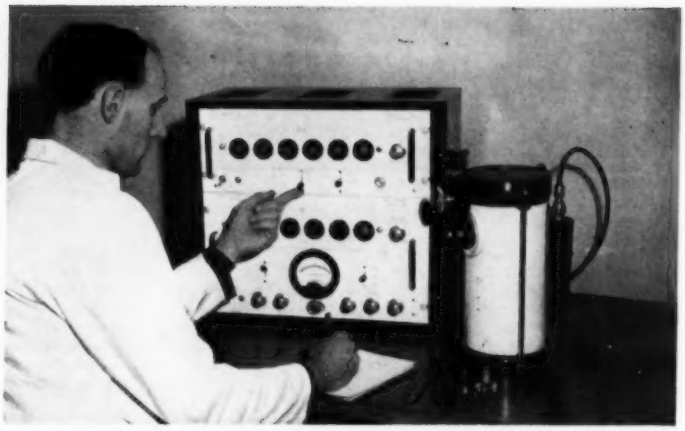
Scintillation Counter

The SC/LP scintillation counter has been developed for the counting of millimicrocurie quantities of very low-energy beta-radiation emitters such as tritium and carbon-14. The counter is intended primarily for use with liquid phosphors but can also be converted to accommodate plastic phosphors and sodium iodide crystals. The equipment consists of a 1½ in. thick (minimum) lead castle fitted with a light-tight door which is interlocked with an EHT switch and a shutter assembly to protect the photomultiplier and to prevent external light increasing the background count.

Normally, a standard 30 ml. glass jar is used as a container for the liquid phosphor into which the radioactive source to be counted is placed: since the shutter provided opens automatically when the castle door is closed and operates a microswitch, samples can be changed in normal room lighting while maintaining a low level of background counts. When in position in the castle, the bottom surface of the glass container is adjacent to the sensitive surface of the photomultiplier tube and a good optical contact is maintained by means of a liquid light guide. The shutter asembly can be replaced by a crystal mount which will accept 1½ in. diameter by 1 in. sodium iodide crystals or plastic phosphors of similar dimensions: by inverting the unit, liquid and solid samples can be investigated with minimum air gap between sample and detector. The high efficiency counting of low-energy beta-emitters in other forms can also be carried out with this equipment.

For counting purposes, the counter is used in conjunction with a linear amplifier and suitable scaling apparatus incorporating discriminator and EHT supplies. Efficiencies of 10 per cent for tritium and 50 per cent for carbon-14 have been obtained at room temperature, but higher counting efficiencies can be achieved by cooling the castle in a standard refrigerator.

(Marketed by: Panax Equipment Ltd., Holmethorpe Industrial Estate, Redhill, Surrey.)



The SC/LP scintillation counter, developed by Panax Equipment Ltd. for the counting of millimicrocurie quantities of very low-energy beta-radiation emitters, comprises a lead castle and associated automatic counting equipment.

Ultraviolet Spectrophotometer

The development in recent years of methods for the manufacture of high quality synthetic optical dispersion media has given the opportunity for new advances in spectroscopy of which leading instrument manufacturers have not been slow to take advantage.

Outstanding among these new materials is high quality fused silica, which has recently become available in sufficient quantities for commercial use. Previously, prisms for ultraviolet spectrometers were made almost exclusively of natural quartz, a material which, however carefully selected, is subject to trace impurities, and which, due to its crystalline structure, presents limitations in cutting. Synthetic silica, on the other hand, while being chemically identical with pure natural quartz can be manufactured under strictly controlled conditions so that virtually no impurities are introduced, and being amorphous, can be cut without difficulty in any orientation.

Due to its extremely high purity, fused silica has considerably better transmitting properties in the ultraviolet region of the spectrum than natural quartz, and for this reason the quartz prism in the SP. 500 ultraviolet spectrophotometer has been replaced with a prism of this new material. The result has been to extend the useful range of the instrument from 200 mμ to the region of atmospheric absorption at 186 mμ, and greatly to improve its performance in the important 200 to 250 mμ range.

(Manufacturers: Unicam Instruments Ltd., Arbury Works, Cambridge.)

Part of the production line of the new model Surgic electric cleaning units ready for despatch to hospitals and laboratories all over the world. Manufactured by Hills of Hull, each Surgic has a wide range of brushes to fit all sizes of containers and new quick-action chucks enable the brushes (of white nylon) to be changed in a second.

NEWS

General

More Historic Foodstuffs Opened

Early in December last, The British Food Manufacturing Industries Research Association opened up four cans of food comprising relics of especial interest offered by the public for the purpose of scientific investigation. These consisted of:

1. A canister dated 1823 (which must surely be the oldest tin of food in the world, as canning was not invented until 1812) believed by the donor to contain plum pudding. It weighed 7 lb. 5 oz. and the manufacturer of both the tin and its contents was the pioneer firm of food canning, Donkin, Hall & Gamble of Bermondsey, London.

It has been established that this tin was part of the provisions of H.M.S. Fury (Captain Sir Edward Parry, R.N.) for his voyage in 1824 to Arctic Regions in search of a North West Passage. This expedition was under Admiralty orders, the 'Fury' and the 'Hecla' being the two ships commissioned. Subsequently and in 1825 the 'Fury' was crushed by ice and Parry decided to abandon ship transferring all stores possible to the 'Hecla'.

Some of the 'Fury's' stores had to be left behind, along with other gear. The tin above mentioned was among them.

The 'Fury's' stores were found four years later. Capt. Sir John Ross in the ship 'Victory', during his voyage of discovery in a further search for a North West Passage, 1829-33.

2. A can dated 1849 and labelled 'Roast Mutton' by William and Thos. Cooper, 134 Leadenhall Street, London. Coopers have ceased manufacturing. The can weighed 4 lb. 13 oz.

This pack of mutton was supplied for the schooner 'Felix' (Sir John Ross, now promoted to Admiral and getting on in years). The 'Felix' was commissioned in 1850 and departed in that year as one of the ships sailing under Admiralty orders to search for Capt. Sir John Franklin, who was more than overdue from his expedition to find a North West Passage and which had left Woolwich in 1845.

Franklin left with 120 men in H.M. ships 'Erebus' and 'Terror' on May 19, 1845. In July that year a whaling captain saw Franklin's ships moored to an iceberg in latitude 74°, longitude 76°. Never more were they to be seen by civilized man.

There were 40 Franklin search parties all told and the party in which Admiral Ross took part in 1850 returned, with little real news of Franklin's fate. The tin of mutton, having not been consumed, came home to England in the 'Felix' and found its way into the Ross household with a companion tin, which was consumed by a Ross relative in 1869 without ill effect.

Dr. F. H. Banfield (right) watches the opening of the 1823 tin.

3. A tin of plum pudding decorated with holly leaves vintage 1900 and manufactured (diestamped) by Crosse and Blackwell Ltd., of Soho, London. The tin weighed 1 lb. 4½ oz.

Crosse and Blackwell took over the pioneer canning firm of Donkin, Hall and Gamble in 1864 and are currently active members of the British Food Manufacturing Research Association.

This 58 year old Crosse and Blackwell plum pudding was manufactured for use in South Africa, never used and subsequently taken by the person to whom it was issued, to the Tropics.

4. The final pack was oblong and consisted of chocolate, sealed in a tin dating back to the 1915 Gallipoli campaign. It measured 7½ in. by 3 in. weighed 11 oz. It was made and sold over the counter as a special wartime package by Fortnum and Mason Ltd., London.

When the cans were opened it was found that the first can, dated 1823 which was thought to contain plum pudding, contained what the Research Association believe to be roast veal. Although the fat had emulsified and a certain amount of shrinkage had taken place, the meat fibres themselves were well preserved and the protein in good condition. A heavy gauge metal had been used for the can. The second can, containing roast mutton, was in much the same condition as the first. The fat had broken down giving a creamy consistency, but the extraordinary thing is that the contents of both these cans, from a bacteriological point of view, were found to be sterile.

Crosse & Blackwell's plum pudding, canned in 1900, was found to be in first class condition, slightly drier than present-day packs, but very well blended and with no sign of rancidity. In view of the high temperatures at which this can had been stored, the condition of its contents was described as truly remarkable.

The chocolate in the fourth can, packed in 1915, had faded in colour and was brittle, the foil wrapping had undergone certain changes and the fat had broken down. It was thought that possibly too much air had got in in the initial packing.

Manufacturers' News

New Glass Industry Research Laboratories

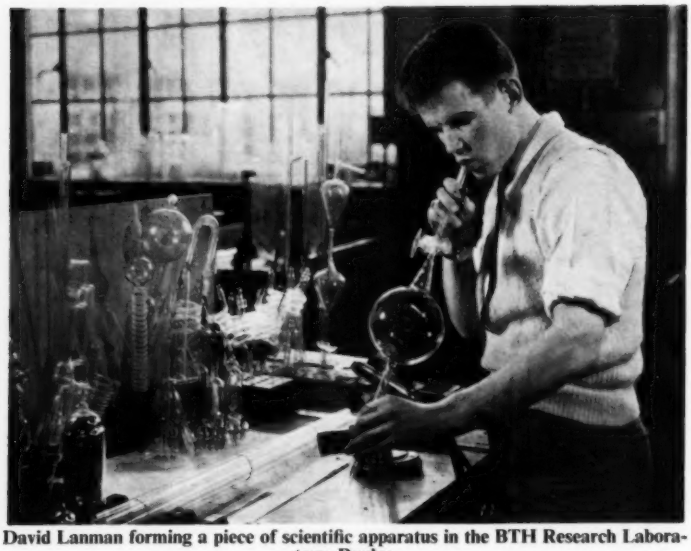
Work has begun on new research laboratories at Lathom Park, Ormskirk, Lancashire, for Pilkington Brothers Limited, the glass manufacturers. It is hoped the laboratories, which form part of an expansion scheme for the company's Research Department, will be completed by June 1960.

They will be used for small, medium and large-scale research work and eventually house 500 employees, of whom 150 will be science graduates.

The buildings will consist of a main block containing an orthodox type laboratory for small scale research work, with offices, a canteen and lecture theatre. There will also be a laboratory for the use of larger equipment and apparatus, and a large-scale laboratory and workshop, where complete new processes can be developed.

Zeal Northern Representative

Mr. D. G. Turner of 66 Windemere Street West, Gateshead on Tyne, 8, County Durham, has now been appointed in succession to the late Mr. G. A. Smith as northern representative for G.H. Zeal Ltd.



David Lanman forming a piece of scientific apparatus in the BTH Research Laboratory, Rugby.

BTH Apprentice Wins Physical Society Competition

In addition to its annual exhibition of scientific instruments and apparatus, the Physical Society each year holds a competiton for apprentices and learners of either sex to encourage craftsmanship in the scientific industry. Since apprentices of the British Thomson-Houston Company were first entered in 1952, they have gained 15 diplomas in the glass blowing section of the competitions, which reflects credit upon Mr. W. V. Baker, Chief Glass Blower in the Research Laboratory at Rugby, who is responsible for their training.

In this year's competition, a glass blowing apprentice at BTH has been awarded two prizes. He is David W. Lanman, of 12 Laburnum Grove, Rugby. In the Class for Blown Glass and Silica Ware, David entered a three-stage mercury diffusion pump in the Blown Glass Section and a double surface silica reflux condenser in the Silica Ware Section. In both instances he was awarded a second prize.

In the 1958 competition, David received honourable mentions in the Class for silica wire and also the Class for Pyrex type glass ware.

Long Service Presentations

H. J. Elliott Ltd., manufacturers of the E-Mil brands of laboratory glassware and thermometers, have announced their intention of making a presentation to all employees with 25 years' service.

The first of these long service presentations, consisting of gold wristlet watches, was made by Mr. H. J. Elliott, founder director of the company, now in his 82nd year, to three members of the staff.

Mr. G. C. Devereux, Manager of the Technical and Development Division, who joined the company in London in 1919, and has completed 40 years service, was presented with a pair of binoculars in addition to a gold wristlet watch.

The other presentations were made to Mr. E. W. Fish, foreman of the Graduating Department, who has over 34 years service, having joined the company in 1924; and Mr. W. A. Broad, superintendent of the Thermometer Department, who has completed 25 years service.

New Glassware Assemblies

A unique method of packaging for laboratory glassware has been introduced by Quickfit & Quartz Ltd. to synchronize with the appearance of a new comprehensive range of assemblages.

Fitted trays, fabricated in an attractive blue plastic material, are moulded to take all parts in each assemblage in the minimum possible space. The trays are of sandwich construction so that the laboratory glassware is totally enclosed by two sheets of protective plastic. The trays have been designed so that they will fit into the standard laboratory bench drawer or cupboard. Alternatively, the plastic trays can be retained in the original box in which they are despatched by the manufacturer and, for storage purposes, conveniently be piled one above the other. This will be of particular help to schools and universities, since 50 or 100 sets can thus be stacked on three or four square feet of floor space. Likewise, these fitted trays make it possible quickly to spot any broken or missing components and, since each component has its reference number moulded into the plastic tray, replacement is made easy.

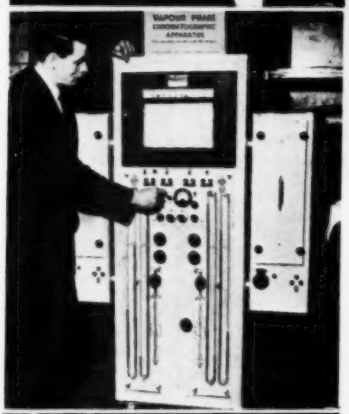
The new assemblages have a price range from £2. 2s. for the smallest set up to £57. 10s. They comprise a progressive series of Quickfit interchangeable sets, from gramme to kilogram size and ranging upwards in content from the smallest set of only five pieces. All components are completely standardized 'Quickfit' parts; this gives the greatest possible versatility with maximum economy and reduces the initial cost while at the same time simplifying replacements.

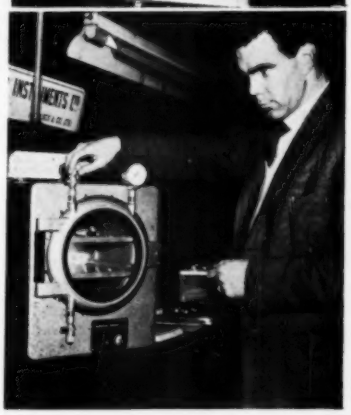
Great attention has been paid by the manufacturers to the contents of each assemblage so that each shall cover the widest possible range of techniques while keeping the number of different parts as small as possible. Careful study has achieved dimensions that give correct sizing for performance and tolerance to allow for perfection of interchangeability. Three sizes of assemblage are available:

1. 30 *BU* which goes up to 2 litre nominal capacity (approximately 1·5 kg.). The complete assemblage is made up of four sets which can be bought separately.
2. 23 *BU* which is of 50 ml. capacity (approximately 30 g.). This assemblage comprises three sets.
3. 10 *BU* which is up to 25 ml. capacity (approximately 15 g.). In addition to the full assemblage, five smaller sets are available. In the case of four of these, provision is made for adding further components as desired to build up the sets into the complete assemblage.

The design of all these sets making up the assemblages is such that, while each set is complete in itself, it can be enlarged simply by obtaining the appropriate extension set to convert the original into a larger set. This applies throughout the entire new range, enabling apparatus to be built up either as work demands or as finance permits.

Some Exhibitors at the R.I.C. Exhibition of Laboratory Apparatus held at the Manchester College of Science and Technology.





Above: Synthetic fused silica shown by The Thermal Syndicate Ltd., a new vapour phase chromatographic apparatus shown by Griffin & George Ltd., and a thermostat vacuum oven shown by Townson & Mercer Ltd.

Below: A new general purpose polarograph was exhibited by the Cambridge Instrument Co., Ltd.

Baird & Tatlock (London) Ltd. showed the new B.T.L. fraction collector which enables up to 600 fractions to be collected during one operation.

A fixed condenser rotary film evaporator was exhibited by J. W. Towers & Co., Ltd.

Australian Exhibition

The first Australian exhibition of automatic analytical instruments is to be held in the Sydney showrooms of Watson Victor Ltd. during the fortnight beginning February 23, 1959. The instruments, with a total value of about £35,000, will be representative of those made by the London firm of Hilger & Watts Ltd., and it is indicative of the faith this firm has in the Australian market (and in the willingness of the Australian manufacturer to accept new methods) that they are prepared to make so heavy an outlay for exhibition purposes. Their Sales Director, Mr. D. R. Stanley, will be at the exhibition together with technical specialists from this country.

Industrialists and scientists will be invited to the exhibition from all over Australia and will be able to see the instruments in full working order. Samples of steel and non-ferrous alloys will be tested and analysed and the results presented in no more than a few minutes. In a country with a large agricultural community and where industrialism is rapidly spreading, so that soil research and metallurgical and other forms of analysis are equally important, the exhibition will undoubtedly arouse widespread interest.

Incubator Prices Reduced

Modernization of manufacturing methods, coupled with increased output, has enabled Charles Hearson & Company Limited to reduce the prices of their standard range of all metal incubators while still maintaining to the full the high performance for which they are noted.

An example of one of the Hearson range of all metal incubators.

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The clean lines and modern appearance of these incubators (which are finished in a standard silver-grey hammered stove enamel), coupled with their high degree of uniformity of temperature distribution and rapid temperature recovery, make it all the more interesting that prices can be reduced in these days of rising costs.

Personal Notes

Overseas Visit

Mr. Edward Gurr, F.R.I.C., F.I.S., M.I.Biol., managing director of Edward Gurr Ltd., has recently returned from South and South Eastern Europe including Turkey, where he visited the company's agents, medical laboratories, etc.

Publications

L.A.C. Collected Papers

Vol. 7 in the Laboratory Animals Centre collected paper series has now been published under the title 'The Organization and Administration of an Animal Division'. This volume comprises the papers read at the L.A.C. Symposium, 1958.

Copies are obtainable (price 10s.) from the publishers: Laboratory Animals Centre, M.R.C. Laboratories, Woodmansterne Road, Carshalton, Surrey.

Tin and its Uses

The autumn issue of this quarterly journal published by the Tin Research Institute describes the advantages of tin-nickel plating in high precision industries, for example, watch and scientific instruments manufacture. Certain properties of the plating, such as throwing power and resistance to corrosion and finger-marking, make it particularly suitable for complex and finely engineered products.

Another article describes how the finish of hot-tinned wares can be improved by the use of a centrifuge of simple design. For small components, a separator or 'breaker' is used in conjunction with the centrifuge. Both pieces of equipment are described and illustrated.

Solder can be cast continuously with simple equipment developed in the Institute's Laboratories. A full description of the method is given.

The value of a hot-dipped tin coating as a means of ensuring perfect soldering of copper wires is stressed in an article which considers the problem of solderability, particularly in the modern printed circuit method of assembling electronic equipment.

MEETINGS FOR THE MONTH

Mid-February to Mid-March

We give below a selection of meetings of interest to laboratory workers. Details are as full as possible at the time of going to press, but readers requiring further information or confirmation of arrangements should contact the organizers.

February 11

The Society for Analytical Chemistry (Midlands Section). At The University, Birmingham, 3. 6.30 p.m. 'Recent Advances in the Analytical Chemistry of Polymers'. Speakers from Fort Dunlop.

The Society of Instrument Technology (Chester Section). Visit to Ellesmere Port Works.

February 13

The Society of Instrument Technology (Midland Section). At Regent House, St. Phillips Place, Colmore Row, Birmingham, 3. 7 p.m. 'Instruments in Surgery and Medicine', by G. Slaney, M.B., CH.B., F.R.C.S.

February 20

The Society for Analytical Chemistry (Microchemistry Group). Annual General Meeting, followed by an address from the retiring chairman, D. F. Phillips, F.R.I.C.

February 25

The Society of Instrument Technology (South Wales Section). In the Physics Lecture Theatre of the Welsh College of Advanced Technology, Cardiff. 6.45 p.m. 'The Development of Flow Measurement', by B. L. Thurley.

March 3

The Society for Analytical Chemistry (Midlands Section). At the University, Birmingham. 6.30 p.m. Annual General Meeting.

March 6

The Society for Analytical Chemistry. In the Meeting Room of the Royal Society, Burlington House, London, W.1. 2.30 p.m. Annual General Meeting followed by the address of the retiring President, J. H. Hamence, M.SC., PH.D., F.R.I.C. The Biennial Dinner will be held on the same day at 7.15 p.m. at Fishmongers' Hall, London Bridge, London, E.C.4.

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1099	**ACID ALIZARIN BLACK SN** T. S. West. *Chem. and Ind.*, 94 (1958).	4272	**FAST SULPHON BLACK F** R. Belcher, R. A. Close and T. S. West. *Chem. and Ind.*, 1647 (1958).
4057·5	**ERIOCHROME BLUE-BLACK B** *Organic Reagents for Metals*, 5th ed., Vol. 1, p. 159. Hopkin & Williams Ltd.	5799·5	**METHYLTHYMOL BLUE** J. Körbl. *Coll. Czech. Chem. Comm.*, **22**, 1789 (1957). R. Pribil. *Analyst*, **83**, 188 (1958).
4057·6	**ERIOCHROME BLUE-BLACK R** (Calcon). C. P. Hildeband and C. N. Reilley. *Anal. Chem.* **29**, 258 (1957); *Anal. Abs.*, **4**, 2518 (1957). P. F. Lott and K. L. Cheng. *Chemist Analyst*, **46**, 30 (1957) *Anal. Abs.*, **4**, 3576 (1957).	9033·5	**XYLENOL ORANGE** J. Körbl, R. Pribil and A. Emr. *Chem. Listy*, **50**, 1440 (1956). J. Körbl and R. Pribil. *Chemist Anylyst*, **45**, 102 (1956). R. Pribil. *Analyst*, **83**, 188 (1958).

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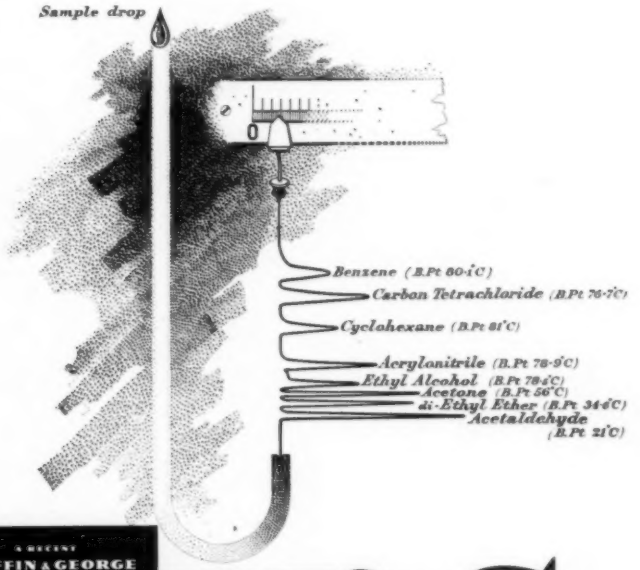

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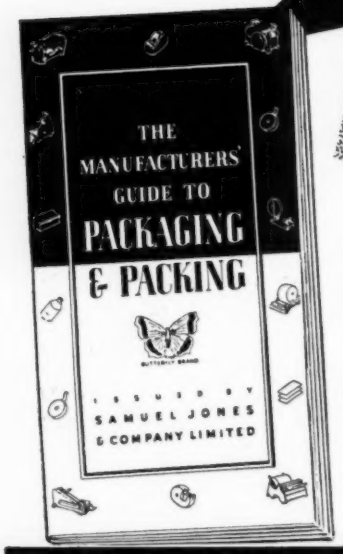

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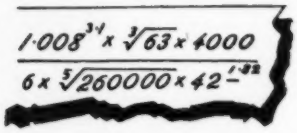

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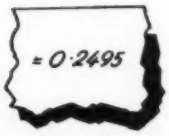

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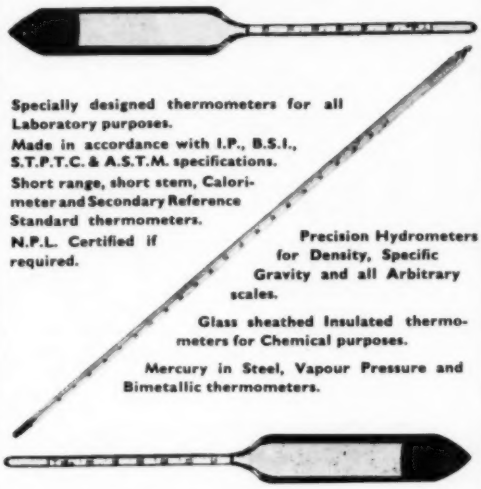

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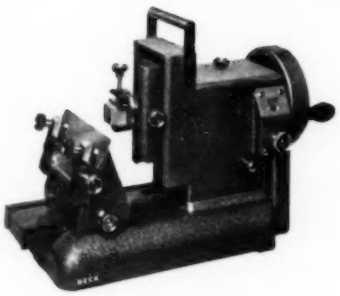

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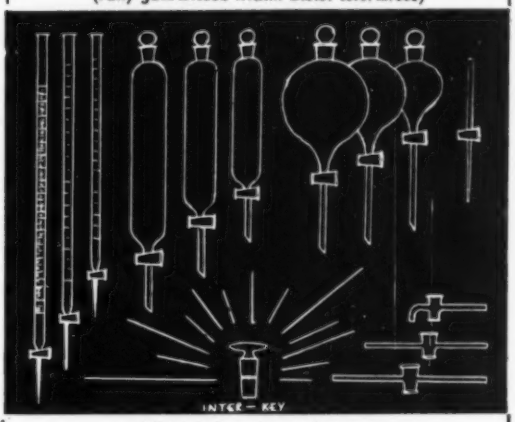

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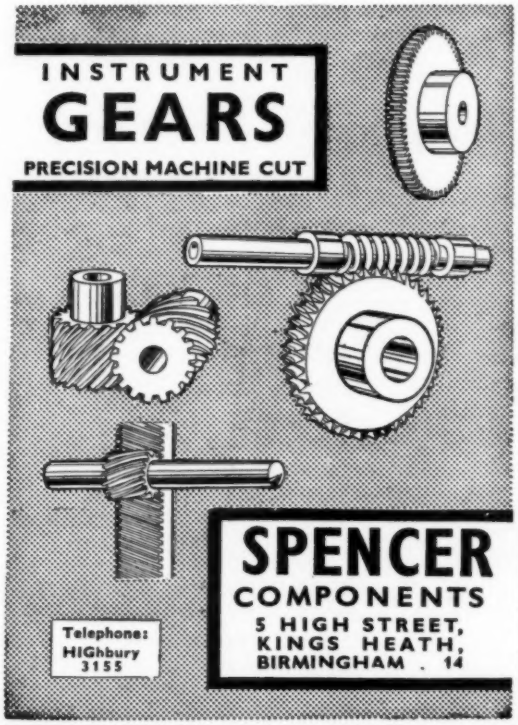

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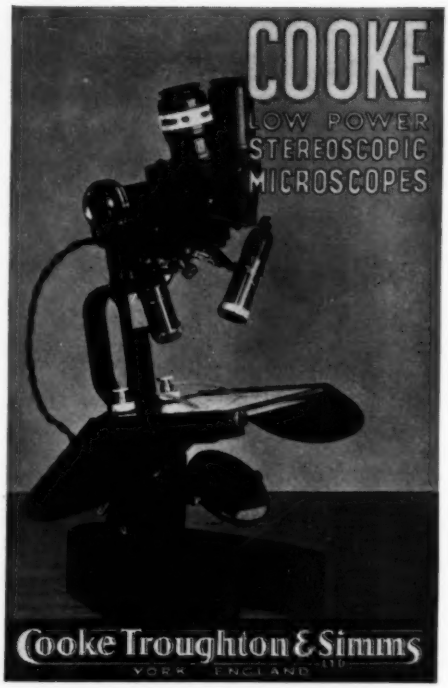

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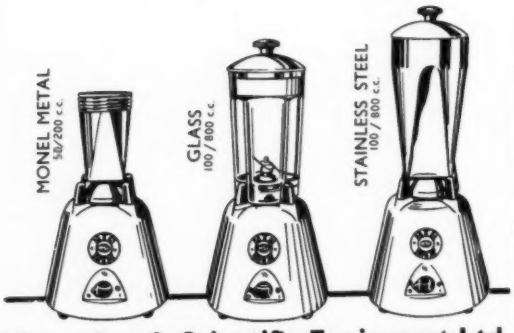

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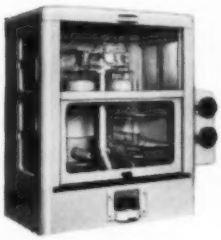

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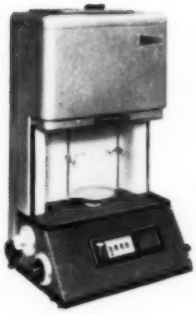

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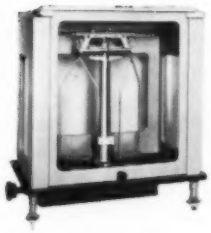

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